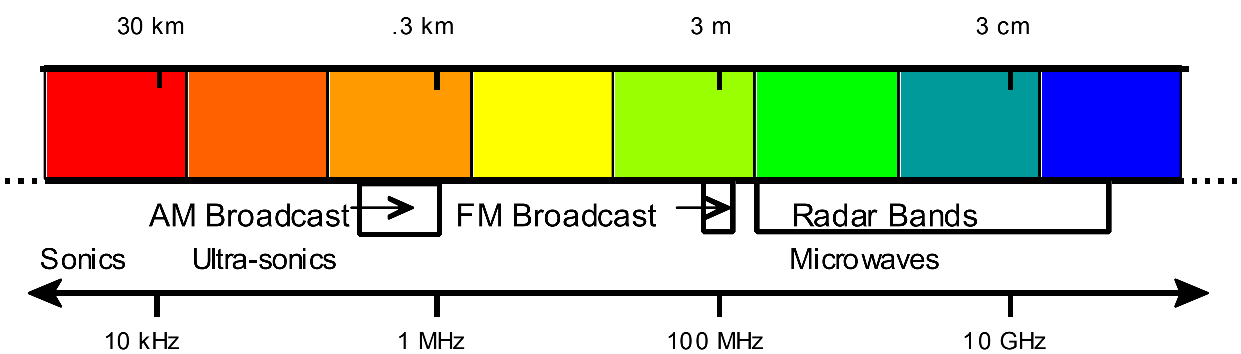
FEDERAL SPECTRUM MANAGEMENT:

HOW THE FEDERAL GOVERNMENT USES & MANAGES THE SPECTRUM



U.S. DEPARTMENT OF COMMERCE
Donald L. Evans, Secretary

John F. Sopko, Acting Assistant Secretary
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INTRODUCTION

Background

Use of the radio spectrum is critical to U.S. communications, and indeed, the national economy. In 1990, the value of shipments of radiocommunications equipment was estimated to be more than $55 billion. The Federal Communications Commission's (FCC) recent auctions of portions of the spectrum for Personal Communications Services, and other services, has produced about $24 billion for the national treasury. Industries that use the spectrum to provide a service, such as broadcasting, cellular telephony and paging also make substantial contributions to the economy, as do manufacturing and service industries that use the spectrum to increase their productivity. Moreover, spectrum use is essential to government functions ranging from defense and public safety to air traffic control and weather forecasting. U.S. policies for managing the spectrum must ensure that the spectrum is used efficiently and fairly to promote the best interests of the public while promoting innovation and serving users' needs. Current spectrum management policies — administered by the National Telecommunication and Information Administration (NTIA) for Federal government users, and by the FCC for all other users — are under increasing strain as the demand for existing spectrum-based services grow and new spectrum-related technologies and applications emerge.

At NTIA we believe, as John Donne stated so eloquently four centuries ago, that:

> No man is an island, entire of itself; every man is a piece of the continent,
> a part of the main . . .

This is especially true in spectrum management since many acts of communicating using radio technology affect a wide area, often adversely. When use of radio technology becomes a widespread and essential part of everyday life, as it has in the United States, all users must understand and protect others' uses. We who manage spectrum use must work with all spectrum users to understand their needs. We must keep the needs of all users in mind to succeed in our goals for a vibrant telecommunication industry, which with the industries it supports, can successfully compete in World Markets.

We seek to form a dynamic partnership between the Federal government and industry; then we can look forward to continuing to meet in the new millennium the broad mandates and goals embodied in the ***Communications Act of 1934.***

As an expression of these ideas, we are committed to American telecommunications excellence in a competitive world through *Leadership, Service, Creativity, Expertise & Teamwork*. For spectrum management this means that we are developing an environment in which spectrum is available to satisfy the radiocommunication needs of the United States while setting up only those regulatory constraints needed to protect the interests of the public and to provide compatibility between spectrum users.

This paper describes some basic elements of spectrum management. It first explains what we mean by *THE SPECTRUM*. Second it portrays the role of the Federal government as a major user of the spectrum explaining how the use of the spectrum is critical to the roles assigned the government agencies by the Congress and the President. Finally, the paper discusses how, why and by whom its use is regulated.

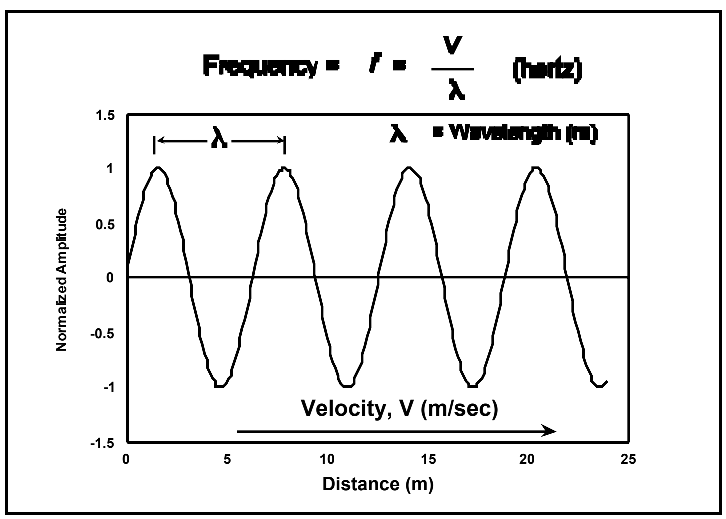
THE SPECTRUM

Perhaps the most familiar part of the electromagnetic spectrum is the *Visible Light Spectrum*. The light with which you are reading this page is, in reality, radiation covering part of the electromagnetic spectrum. In fact, the term "spectrum" was originally limited to light. The great physicists of the 17th through 19th centuries were the first to realize that what we think of as white light is really a broad range of different light colors from the brightest red at one end to the deepest purple at the other. Thus, white light is a *spectrum* of different colors.

> That white light is a *Spectrum,* or a broad, continuous range of light, can be shown by experiments with a prism, and can be seen in a rainbow or in the refractive splotches of color created by the Sun and beveled glass.

Light exhibits properties of waves and can be focused and bent like waves in a pond. Just as a wave traveling through water has a wavelength (the distance between wave crests) and a frequency (the number of wave crests passing a point in a unit of time), light has a wavelength and a frequency. Red light has the longest wavelength and lowest frequency while purple light has the shortest wavelength and highest frequency.

The electromagnetic spectrum extends in both directions from the visible range. Shorter-wavelength, higher frequency "light" includes ultraviolet, x-rays, and cosmic rays. Longer-wavelength, lower-frequency "light" includes first infrared light then, as wavelengths become longer and longer, radio waves. The early physicists also found that both electric and magnetic fields surround electrons traveling through wires, and that electric and magnetic fields varying in



RELATIONSHIPS BETWEEN WAVELENGTH & FREQUENCY

intensity at the same frequency as the electric current surround a wire carrying an alternating current. Furthermore, the wire radiates energy that propagates just as do light waves with a frequency and wavelength corresponding to the frequency of the alternating current in the wire.

The basic developments of Hertz and Marconi in the waning years of the 19th century preceded radio transmission of voice and music signals by only a decade. Commercial broadcasting began in 1920 when the Department of Commerce granted KDKA in Pittsburgh a license. All that was required to use radio techniques for these purposes was to develop ways to achieve the following: first, add the voice or music signals to a suitable alternating current called the carrier (modulating the carrier with the information signal); second, generate an electromagnetic wave capable of detection at a distant site using Hertz's and Marconi's findings; third, remove the information signal from the carrier (demodulating the carrier); and finally, convert the electrical signals to sound waves that the listener can hear. These technical achievements were being pursued in the telephone and recording industries, and thus, were quickly available for broadcasting.

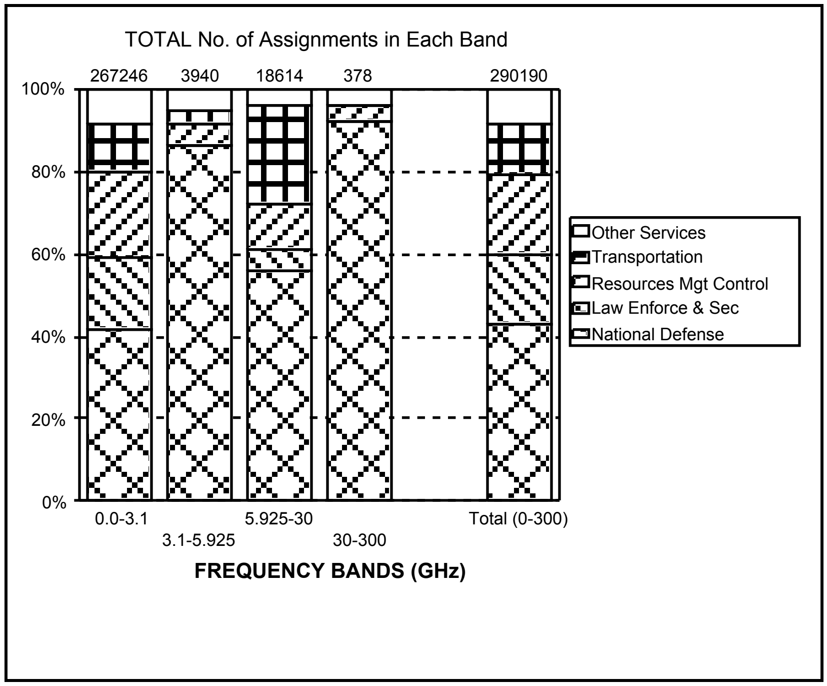
> Heinrich Hertz discovered electromagnetic waves in experiments between 1886 and 1888, when he found that the oscillations in a resonant circuit could excite sympathetic oscillations in a distant tuned circuit. His production of waves with the same character as light led rapidly to the development by Guglielmo Marconi of wireless radiotelegraphy in 1896, and transatlantic transmission of signals in 1901, and to the broadcast of speech and music in 1906. To honor Hertz's accomplishments, the unit for frequency, previously called "cycles per second," is now known as the ***Hertz***.

Today, the spectrum is used in many different ways. Perhaps the most common are the broadcasting and mobile communication services. These include, for broadcasting, AM and FM radio stations, UHF and VHF television stations, and new applications using satellites for direct broadcasting to the home. Mobile communication services in the private sector include police and fire communications at the state and local levels, other state and local dispatch services, all forms of mobile communications systems used by business and industry and the public, citizen's band radio, maritime radios aboard commercial and pleasure vessels, cellular radio, paging systems, trunked radio systems offered by the FCC's Specialized Mobile Radio Service, the new Personal Communications Service, radios in commercial airplanes used for aeronautical radionavigation and communications, and mobile satellite communications and tracking systems. In addition, large portions of the spectrum are used for carrying voice, data, and video signals over long distances via microwave relay and satellite systems.

GOVERNMENT USE OF THE SPECTRUM

HOW THE GOVERNMENT USES THE SPECTRUM

The chart at the right shows some different ways that the Federal Government uses the spectrum to help in the accomplishment of its tasks. These uses include Voice of America broadcasts, weather radio services, radars and voice communication systems used to control both commercial and pleasure aeronautical and maritime traffic, weather satellite systems, flood warning and water control systems, and time signals. Almost 90% of the assignments authorizing government radio stations are below 3.1 GHz. The DOD uses a significant portion of the Federal government spectrum for national security needs. The Federal government uses only the portions of the spectrum that it needs to provide critical public services, and seeks to deploy the most efficient technology consistent with available resources.



GOVERNMENT USE OF THE SPECTRUM: SELECTED BANDS BELOW 300 GHZ

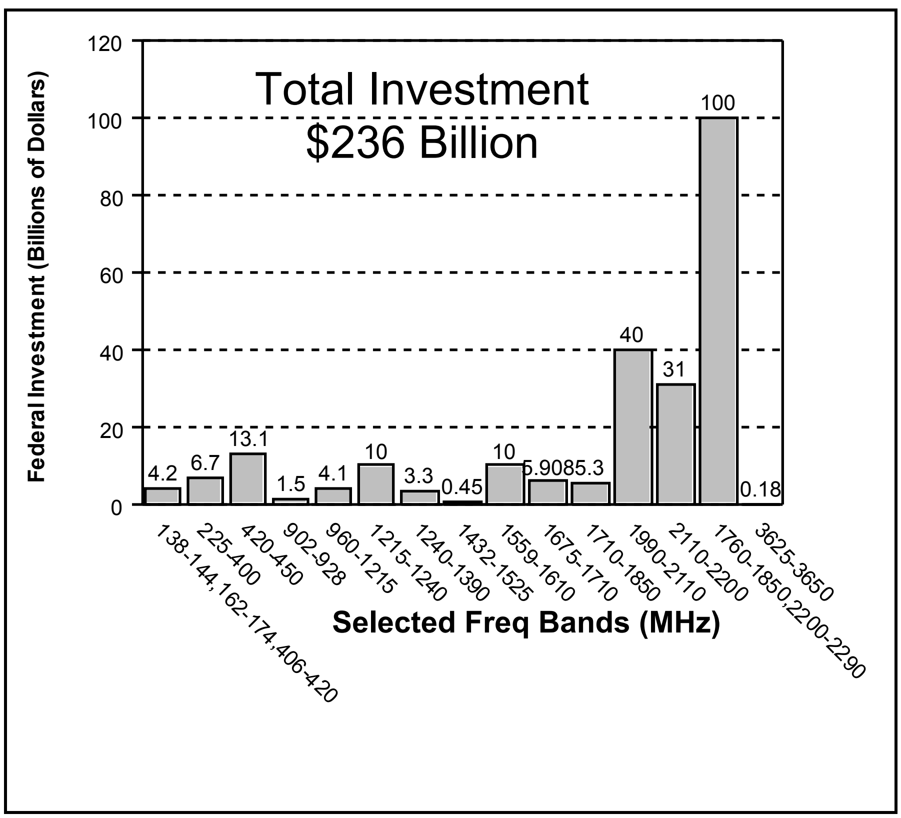
As is discussed more completely below, almost every agency of the Federal Government uses the spectrum in performing mandated missions. Two dominant themes are always present in the government's use of radio:

1. The requirement for telecommunication is placed upon the Federal agencies by virtue of the missions and programs approved by the President consistent with congressional legislative and funding support.

2. The use of radio, rather than other forms of communications, is dictated by the type of service required and the inescapable elements of time and space.

The law enforcement agencies (*e.g.,* Justice, Treasury, and Interior Departments) use the spectrum for command and control of their forces, just as state and local police and fire departments do, with the exception that they must be able to operate throughout the United States. The Federal Aviation Administration uses it for safety services such as aeronautical radionavigation, precision landing systems for all weather operations, surveillance, and air/ground communications. Department of Agriculture Forest Service rangers use the spectrum every time they use their transportable radios for control of crowds or forest fires. The Department of Energy uses it to transmit power control data and commands for their dams and power grids. The Federal Emergency Management Agency uses it for communications in disaster areas via emergency radio networks. The National Aeronautics and Space Administration uses it during satellite launches for communications with satellites to collect data and command them. NASA must also use the spectrum to track launch vehicles and satellites and destroy them if necessary. The Department of Defense (DOD) uses the spectrum extensively for tactical and non-tactical uses. In the United States tactical uses are generally limited to several specific testing sites and training facilities. However, DOD's non-tactical applications are extensive and include aircraft command and control, mobile communication at military bases and air fields and long distance communications using satellites.

The distribution of frequency assignments in the adjacent box reflects the Federal government's use of the spectrum. Its investment in selected bands below 3650 MHz totals about $236 billion, as shown. This investment in technology affects the Federal government's ability to relocate to new spectrum bands. The recent Federal government reallocation of 235 MHz to the private sector, for example, will cost taxpayers an estimated $500 million to move the Federal government users. Please note that the $100-billion investment in the 1760-1850 and 2200-2290 MHz bands includes most Federal space sys-



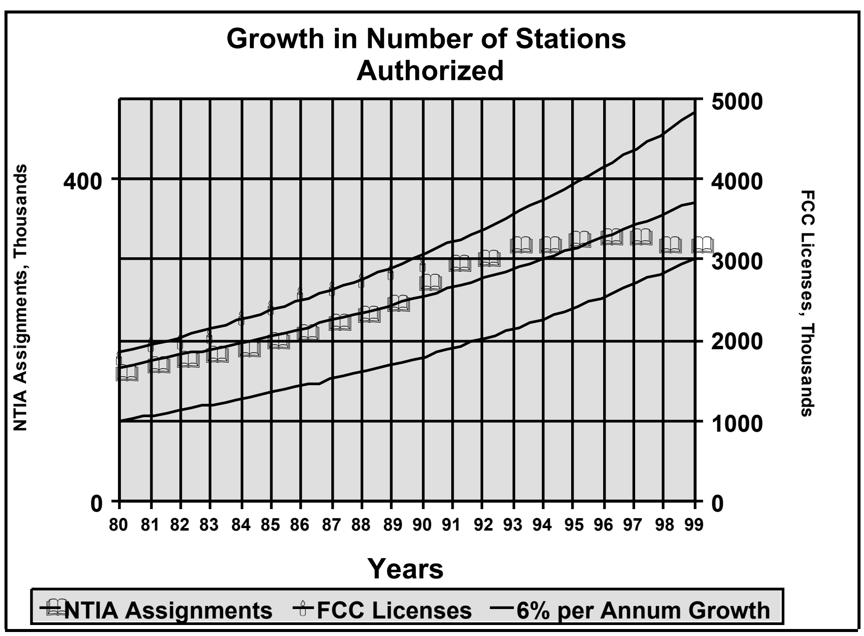
FEDERAL INVESTMENT IN SELECTED FREQUENCY BANDS

tems, but not the Federal investments of $5.3-billion for fixed and mobile service operations in the 1710-1850 MHz band.

In understanding the Federal government's use of the spectrum, one must appreciate the interplay between Federal government and non-federal government use of the same spectrum. In addition to the shared use of the same sections of spectrum for unrelated purposes, there is a substantial interface between government and non-government radio operations. Government radio facilities provide private sector ships and aircraft communications, navigation, and surveillance service; Federal law enforcement agencies have intercommunication with their state and local government counterparts; Federal electrical power systems interconnect with non-federal power systems, both domestic and international; Civil Air Patrol stations communicate with the military — and so forth.

HOW THE SPECTRUM IS SHARED

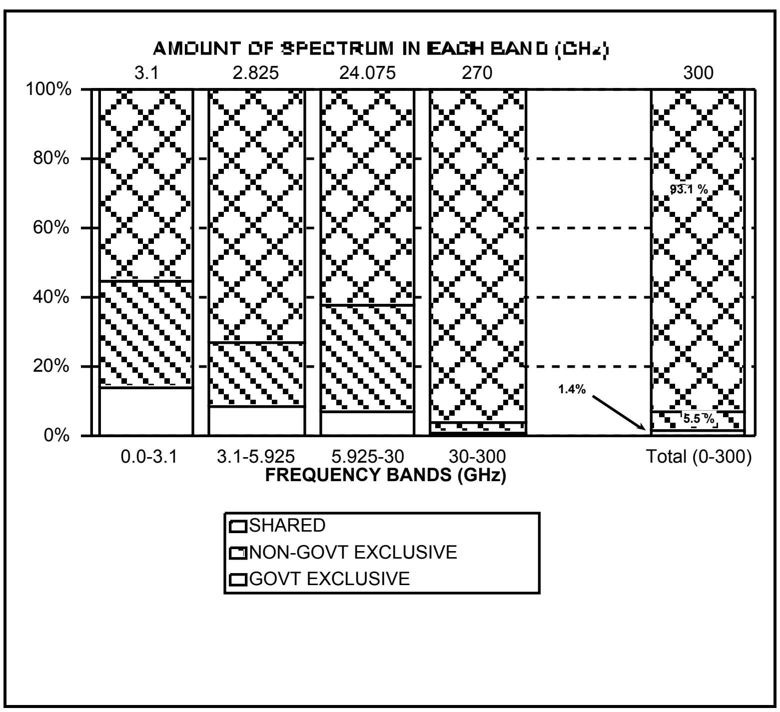
There can be little argument that some form of coordination of operating frequencies and transmitting powers is necessary; after all, the present structure was developed largely because of the interference problems resulting from uncoordinated broadcasting and long-distance (High-Frequency) transmissions common during the first two decades of this century. While most radio spectrum is very congested, it is not normally necessary to regulate tightly spectrum in those portions of the spectrum that are not congested. Thus, as long as the spectrum is plentiful, merely assuring that two users do not operate in the same part of the spectrum in the same area is sufficient. As the spectrum becomes more crowded, efforts to insure that the spectrum is used as efficiently as possible to maximize its availability to and use by all become more urgent.



Until recently, advancing technology has always kept slightly ahead of the demand for spectrum. As demand for spectrum has increased, technology has developed radios that can perform the same function at higher unused frequencies or increase spectrum efficiency and re-use of existing frequencies. Now, demand for spectrum is growing rapidly, both from expanded use of current services like cellular radio and precision landing systems for improved aviation safety, and the development of new uses, such as personal communications services (PCS), digital audio broadcasting, and advanced television (ATV). However, the technical advances needed to meet that demand may be "pushing the envelope" of practicality, at least in the short term. New technology cannot be expected to achieve further spectrum efficiency in the crowded radio spectrum below 3 GHz and affordable technology is not readily available for consumer wireless communications above 20 GHz.

The adjacent box shows the growth in the number of active frequency authorizations at both NTIA and the FCC since 1980. At both agencies, there are twice as many assignments now as there were in 1980. Further, radio systems clearly are much more numerous today, they have also become more complex during this period, and the task of coordinating their use has become much more difficult. The flattening of the growth curve for NTIA assignments beginning in 1994 is the result of a congressionally mandated fee structure. At that time, NTIA began to charge an annual fee for each frequency assignment.

NTIA and the FCC manage their respective constituents' uses of the spectrum; however, both must keep in mind the overall best interests of the public. The two spectrum managers have divided the usable radio spectrum (0-300 GHz) into about 800 frequency bands, and have allocated these bands to 34 radio services (*e.g.,* fixed, radionavigation, mobile, broadcasting, and various satellite services). The allocation plan continues to change to meet evolving domestic and international spectrum needs.



SPECTRUM ALLOCATED TO GOVERNMENT & NON-GOVERNMENT USE

The adjacent box shows the amount of spectrum allocated in the entire 0-300 GHz range to the Federal government on an exclusive basis to be 1.42%, to the private sector on an exclusive basis to be 5.52%, and to the Federal government and the private sector on a shared basis to be 93.1%. In addition, the box shows that even in the range of the spectrum where the government has 90% of its operations – the 0-3.1 GHz range – the amount allocated to the government on an exclusive basis is about 14%, to the private sector on an exclusive basis is about 30% and to both the Federal government and the private sector on a shared basis is about 56%.

REGULATING THE USE OF SPECTRUM

INTRODUCTION

Electromagnetic waves propagate outward in all directions. A transmitter generally is designed to communicate with a particular receiver; the transmitting antenna directs the majority of the signal toward that receiver and the receiving antenna is situated so that it is most sensitive to signals coming from the direction of the transmitter. However, antennas also radiate lower level signals in all directions or receive high power signals from all directions. Moreover, an interfering signal will be amplified and detected just like the desired signal once it passes from the antenna to the receiver. If the interfering signal is sufficiently large, it can prevent the desired signal from being properly demodulated and understood.

Users of radiocommunication devices in a given area must cooperate if they are to avoid interference problems. If they operate on the same frequencies, at the same time and in the same area, their transmissions will likely produce interference in each other's receivers. Each user, in effect, prevents other simultaneous, nearby uses of some of the spectrum while transmitting.

The electromagnetic spectrum exhibits some of the properties of what economists call a *Common Good*. While there may be substantial costs in designing, building, and operating radio stations, the use of the spectrum, has been essentially free. Until very recently the only costs were modest license fees. Each user had little incentive to individually use the spectrum efficiently since there was little savings; and was, in fact, motivated to secure for his own use the maximum amount of spectrum. However, uncoordinated, wasteful use can easily result in everyone suffering interference, that prevents satisfactory operation, and denies access to new users.

> The term ***Common Good*** originated from the rights of English farmers to feed and water livestock in the Commons, the grounds belonging to the public. Each farmer could have unlimited access to the commons for such purposes and thus had an incentive to maximize his use. However, such unlimited use could easily deplete the resource, and access was eventually controlled by government regulation so that the public could obtain the maximum utility from the good.

The electromagnetic spectrum is an unusual common good, or natural resource because, unlike ores, oil, or coal, use does not destroy it. When one user stops using a portion of the spectrum, another can readily use it. The spectrum is scarce, though, because at any given time and place one use of a portion of the spectrum precludes any other use of that portion.

We regulate the use of the radio spectrum, control its accessability, and enforce rules for its use because of the possibilities of interference between uncoordinated and incompatible uses. In the broadcasting service alone, the broadcaster must know where the station's signal can be received in order to meet the needs of advertisers. Interference is unacceptable because it unnaturally limits the broadcaster's market. Similarly, a taxi company or a police department must be able to determine their coverage areas reliably and know that they will be able to operate without interference in that area.

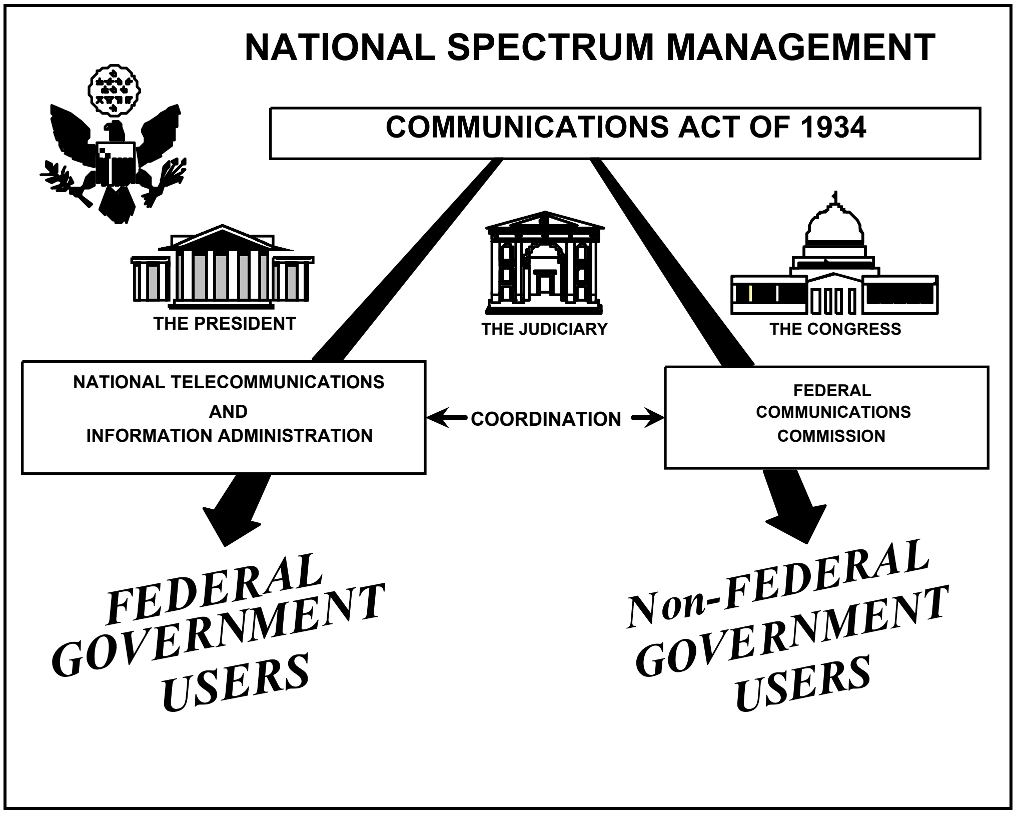
WHO REGULATES THE SPECTRUM

In 1906, the year when speech and music were first broadcast using radio, the first international radio conference was held because of the widely recognized need to coordinate and control the use of the spectrum between 500 and 1500 kHz. In the United States, the clamor for regulation resulting from widespread interference caused by unchecked transmission resulted in the **Radio Act of 1912**. The 1912 Act required the registration of transmitters with the Department of Commerce but did not provide for the control of their frequencies, operating times, and station output powers. Thus, there was no real regulatory power, and the 1912 Act was largely unsuccessful. However, in 1922 U.S. government users of the spectrum banded together under the Secretary of Commerce to form the **Interdepartment Radio Advisory Committee (IRAC)** to coordinate their use of the spectrum. The Government's use of the spectrum was more easily coordinated than the public's because the IRAC represented **all** of the federal users, **and they found that cooperation was mutually beneficial**.

> Use of a *parking lot* is analogous to use of the electromagnetic spectrum. The lot can accommodate a number of different sized and shaped vehicles, but use by any vehicle prevents use of the space "consumed" until the vehicle is moved; then the space can be used in an entirely different way. Indeed, parking lots are often divided into equal size parking spaces, which are analogous to equal sized channels in the radio spectrum. The parking lot and the spectrum can each accommodate different uses at different times. Some types of use require more of the resource than others (a motorcycle or narrowband signal takes less of the resource than a limousine or a wideband microwave signal). If the lot is to be divided into equal sized spaces and the spectrum into equal sized channels, the spaces and channels must be capable of accommodating the largest possible user. Thus, the narrow motorcycle and the narrowband voice radio will consume as much of the resource, a space or a channel, as the fat limousine and the wide-band microwave radio. Ways to avoid this problem include allowing the different sized users to intermingle at will or reserving certain parts of the parking lot or spectrum for different sized uses.

The **Radio Act of 1927** established the **Federal Radio Commission**, and the **Communications Act of 1934** ("the Act," 47 U.S.C. § 151 *et seq.*), established the **Federal Communications Commission (FCC)**. The 1934 Act gave the FCC broad regulatory powers in both wire-line-based communications, such as telephone and telegraph systems and radio-based communications, limited at the time to broadcasting, long distance single channel voice communications, maritime and aeronautical communications, and experiments that led to radar and television applications.

Section 305 of the Act **preserves for the President the authority to assign frequencies to all Federal Government owned or operated radio stations**. In addition, the President retains the



authority to assign frequencies to foreign embassies in Washington, D.C., and to regulate the characteristics and permissible uses of the Government's radio equipment. The IRAC, whose existence and actions were affirmed by the President in 1927, has continued to advise whoever has been responsible for exercising the Section 305 powers of the President. These powers currently are delegated to the Assistant Secretary of Commerce for Communications and Information who is also the Administrator of the **National Telecommunications and Information Administration (NTIA)**.

As shown on the next page, the use of the electromagnetic spectrum in the United States is managed using a dual organizational structure; NTIA manages the Federal Government's use of the spectrum while the FCC manages all other uses. The Act provides for the functions of developing classes of radio service, allocating frequency bands to the various services, and authorizing frequency use. However, the Act does not mandate specific allocations of bands for exclusive Federal or non-federal use; all such allocations stem from agreements between NTIA and the FCC. In other words, there are no statutory "Federal" or "non-federal" bands.

ORGANIZING TO MANAGE THE SPECTRUM

NATIONAL SPECTRUM MANAGEMENT GOALS

The Communications Act of 1934 provides, in Section 151, guidance regarding spectrum management objectives. It states that the FCC is to regulate:

> so as to make available . . . a rapid, efficient, Nation-wide, and world-wide wire and radio communication service with adequate facilities at reasonable charges, for the purpose of the national defense, [and] for the purpose of promoting safety of life and property.

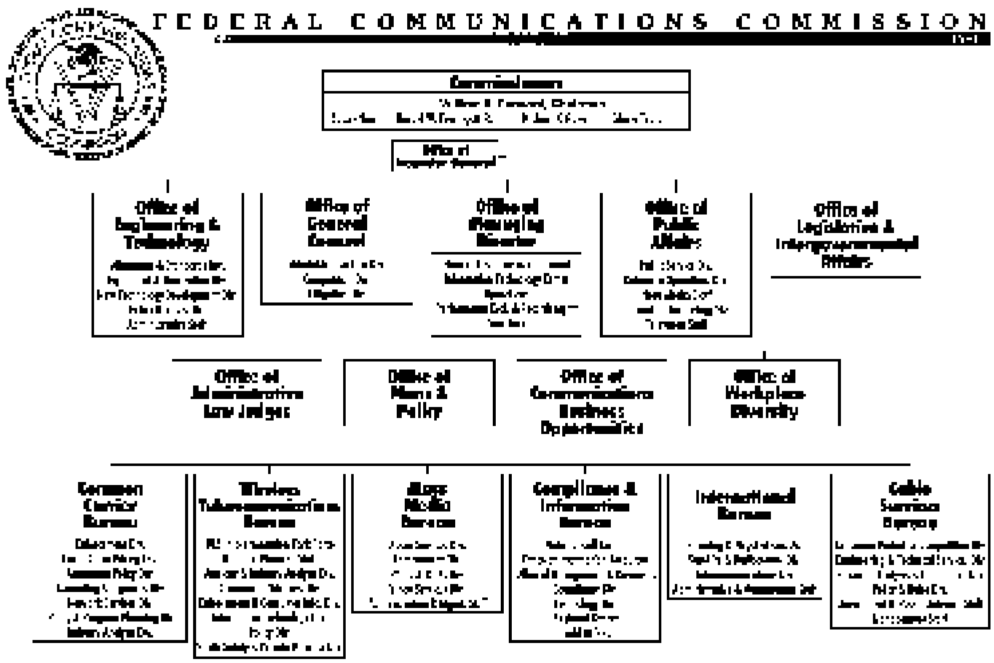
Title III of the Act authorizes the FCC to regulate generally the "channels of radio transmission," including the licensing and operation of radio stations, but provides few details on the FCC's objectives for spectrum management. The Act empowers the FCC to act consistently with the "public interest, convenience, or necessity." The "public interest" standard is the primary criterion for apportioning non-federal spectrum in the United States, although the Act mentions the goals of preventing interference among stations, promoting the efficient use of spectrum, and promoting public safety. The Act does not define the "public interest," but instead gives the FCC broad discretion to elucidate and give specific content to the public interest standard.

NTIA has identified spectrum management objectives to guide Federal users of the radio spectrum. These objectives are similar in intent to the Act's guidelines and state that the Federal agencies are to "make effective, efficient, and prudent use of the radio spectrum in the best interest of the Nation, with care to conserve it for uses where other means of communication are not available or feasible." NTIA interprets the standard "effective, efficient, and prudent," and the reference to "the best interests of the Nation" as encompassing the overall benefits the American public derives from radiocommunication services, both Federal and non-federal, as well as the needs of various Federal users and choices among competing users.

THE FCC

The FCC is an independent federal regulatory agency responsible directly to Congress. Established by the Communications Act of 1934, it is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. Its jurisdiction covers the 50 states and territories, the District of Columbia and U.S. possessions. The FCC is directed by five Commissioners appointed by the President and confirmed by the Senate for 5-year terms.

The President designates one Commissioner to serve as Chairman. As the chief executive officer of the Commission, the Chairman delegates management and administrative responsibility to the Managing Director. Certain other functions are delegated to staff units and bureaus and to committees of Commissioners. The Commissioners hold regular open and closed agenda meetings and special meetings. They also may act between meetings by "circulation," a procedure by which a document is submitted to each Commissioner individually for consideration and official action.



The FCC has seven major regulatory bureaus or offices as shown in the Figure at the top of the next page:

The **COMMON CARRIER BUREAU (CCB)** regulates interstate 'common carrier' services such as telephone and telegraph companies. This includes voice, fax and other transmissions via wire, satellite, optical fiber, and other means. Intrastate communications are generally under the jurisdiction of state utility commissions. The objective of regulation is to provide customers with rapid, efficient, nationwide and worldwide services at reasonable rates. As technology and the marketplace changes, competition now often fulfills this objective. Accordingly, CCB seeks to eliminate unnecessary burdens on carriers and consumers.

The **MASS MEDIA BUREAU (MMB)** regulates the television and radio stations in the United States. The Bureau issues broadcast licenses specifying the community of license, the channel and operating power of the station. The conditions of the license ensure that the broadcast will be picked up without interference. If problems arise, the Bureau investigates and resolves the problems. MMB can fine a station or take its license if it finds that a broadcaster is violating FCC rules.

FCC rules generally do not govern the selection of programming that is broadcast. The main exceptions are that broadcasters may not broadcast obscene programming; they may broadcast indecent programming only when there is a strong probability that no children are in the audience; and they must limit the number of commercials aired during programming aimed at children. There are also rules to ensure that candidates for public office are able to have access to the air for their paid political ads.

The **WIRELESS TELECOMMUNICATIONS BUREAU (WTB)** handles all FCC domestic wireless telecommunications programs and policies, except those involving satellite communications. Wireless communications services, includes cellular telephone, paging, personal communications services, public safety and other commercial and private radio services. WTB regulates wireless telecommunications providers and licensees. The Bureau also serves as the Commission's principal policy and administrative resource concerning spectrum auctions.

The WTB has seven divisions: Commercial Radio Division, Enforcement Division, Policy Division, Auctions Division, Private Radio Division, Licensing Division, and Customer Services Division.

The **CABLE SERVICES BUREAU (CSB)** provides a single point-of-contact for cable related issues before the Commission. The Bureau implements the Cable Television Consumer Protection and Competition Act of 1992 by: promoting the availability to the public of cable television service; promoting competition in the cable marketplace; ensuring growth and development in the cable industry; and ensuring reasonable rates for consumers in areas that do not have competition to the cable system. The Cable Services Bureau is responsible for policy and rule making in cable television, and enforcement of the 1992 Cable Act.

The **INTERNATIONAL BUREAU** handles all FCC international telecommunications and satellite programs and policies. The Telecommunications Division develops policy, rules, and procedures for regulation of telecommunication facilities and services. It also participates in international conferences on issues involving rates, standards, and development. The Satellite and Radiocommunications division licenses and regulates satellite and earth station facilities, both international and domestic. The Planning and Negotiations Division develops international agreements and ensures that FCC regulations comply with international agreements.

The **COMPLIANCE & INFORMATION BUREAU (CIB)** is the Commission's primary point of contact with the public. Through its field office personnel, it carries out the enforcement, public service, and engineering programs of the agency. The Compliance Program ensures that U.S. radio laws and FCC rules are observed. CIB inspects stations, resolves interference problems, monitors the radio spectrum to make sure that channels remain usable and free from interference, certifies radio-equipped ships to sail, and assists rescue agencies. The Bureau pursues administrative and criminal sanctions against parties that violate the laws and rules.

CIB also develops activities to inform assist, and educate licensees, user groups, industry groups, and the public in all matters within the agency's purview. Field staff give presentations and answer questions in areas such as tower marking and lighting, operator services providers, modernization of the EBS, cable television signal leakage, AM directional stations, and consumer problems. CIB distributes forms for franchisees and complaints.

The **OFFICE OF ENGINEERING AND TECHNOLOGY (OET)** manages the spectrum and provide leadership to create new opportunities for competitive technologies and services for the American public. Its primary functions are: Allocations and Policy development; Experimental licensing; Assistance to other federal agencies; Spectrum management and analysis; Technical standards; Equipment authorization; Advise the Commission and Bureaus on technical matters; Provide educational programs on technical matters; Conduct engineering and technical studies; Administer Parts 2, 5, 15, and 18 of the

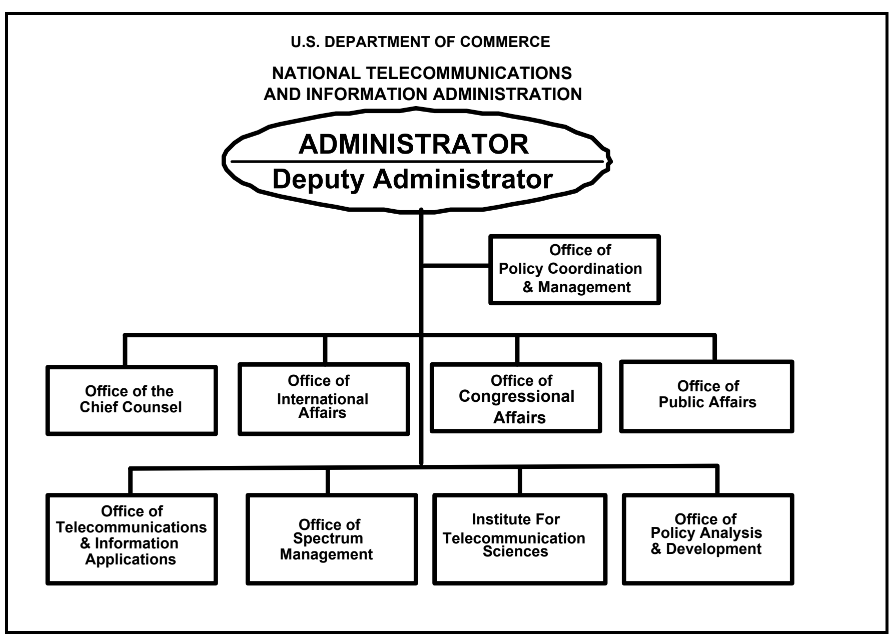
Commission's Rules; Maintain liaison with other agencies and foreign governments on allocations and technical matters; Government coordination; and, Experimental Radio Service.

THE NTIA

The National Telecommunications and Information Administration (NTIA) of the U.S. Department of Commerce was established in 1978 by Executive Order 12046. They codified these functions as a result of the National Telecommunications and Information Administration Organization Act, P.L. 102-538, 106 Stat.3533 (codified at 47 U.S.C. 901-904). NTIA is the Executive branch telecommunications policy advisor to the President and the manager of Federal government uses of the spectrum. NTIA responsibilities are divided among five offices and three staff groups, shown at the top of the next page, which work together to investigate the changing field of telecommunications as America approaches the twenty-first century.

The goal of NTIA's **OFFICE OF INTERNATIONAL AFFAIRS (OIA)** is to provide policy analyses, technical guidance, and representation in international forums, to advance the strategic interests and the international competitiveness of the United States before a diverse, worldwide audience.

OIA's wide variety of activities are designed to further advance and promote these U.S. interests by advocating: 1) telecommunications and information standards consistent with U.S. objectives; 2) regulations governing the international use of the radio frequency spectrum; 3) regulatory policies pertaining to the provision of information and telecommunications services both within and between U.S. and foreign markets; and, 4) the deployment of new technologies in these markets, to improve global communications and expand trade opportunities for our citizens.



OIA advocates Executive Branch policy perspectives in bilateral and multilateral consultations with foreign governments, in international regulatory conferences, and in other forums dealing with Global Information Infrastructure issues. Specific oversight responsibilities include, in cooperation with the State Department and with the FCC, the Communications

Satellite Corporation (COMSAT) its activities in the International Telecommunications Satellite Organization (Intelsat) and the International Mobile Satellite Organization (INMARSAT).

To improve U.S. competitiveness in international markets, OIA provides policy and technical counsel to diverse U.S. interests. To support its representational and counseling activities, OIA tracks market development opportunities by maintaining a database on regulatory, technical, and commercial information for foreign telecommunications and information markets. This information is collected in a timely manner and distributed as requested throughout the world.

NTIA's **OFFICE OF TELECOMMUNICATIONS AND INFORMATION APPLICATIONS (OTIA)** assists state and local governments, educations and health care entities, libraries, public service agencies, and other groups in effectively using telecommunications and information technologies to better provide public services and advance other national goals. This is accomplished through the administration of the Telecommunications and Information Infrastructure Assistance Program and the Public Telecommunications Facilities Program.

The Telecommunications and Information Infrastructure Assistance Program (TIIAP) promotes the widespread use of advanced telecommunications and information technologies in the public and nonprofit sectors. The program provides matching demonstration and planning grants to state and local governments, health care providers, school districts, libraries, social service organizations, public safety services, and other nonprofit entities to help them develop information infrastructures and services that are accessible to all citizens, in rural as well as urban areas. The program was specifically created to support the development of the National Information Infrastructure.

The Public Telecommunications Facilities Program (PTFP) supports the expansion and improvement of public telecommunications services by providing matching grants for equipment that disseminate noncommercial educational and cultural programs to the American public. The main objective of the program is to extend the delivery of public radio and television to unserved areas of the United States. Under the program's authority, funds are also allocated to support the Pan-Pacific Educational and Cultural Experiments by Satellite (PEACESAT) project. PEACESAT provides satellite-delivered education, medical, and environmental emergency telecommunications to many small-island nations and territories in the Pacific Ocean region.

The **OFFICE OF SPECTRUM MANAGEMENT (OSM)**, develops and implements policies and procedures for domestic issues regarding the use of the spectrum and assigning frequencies to the stations operated by the Federal Government in the United States. OSM develops long range plans and policies for the management of the spectrum, the review of Federal radiocommunication systems to make sure that sufficient spectrum is available for their compatible operation, the analysis and resolution of interference problems involving Federal radiocommunication systems, and the analysis of spectrum use in selected bands through state-of-the-art analytic and measurement techniques.

Among OSM's functions are the processing of 8-10,000 frequency assignment actions from 53 Federal agencies each month and the maintenance of a 400,000 record data base of these actions. OSM also reviews about 90 major new Federal radiocommunication systems each year to make sure that spectrum will be available to support their operations. In addition, the Deputy Associate Administrator of OSM chairs, and OSM staff supports, the Interdepartment Radio Advisory Committee (IRAC) composed of 20 representatives of Federal agencies that advises NTIA on rules and regulations and policies for Federal use of the spectrum. Further, OSM, in close concert with OIA, prepares Executive Branch inputs for International regulatory conferences and implements the results of those conferences. OSM provides strong technical and policy guidance for contingency and emergency planning as well as for strategic spectrum planning.

The **INSTITUTE FOR TELECOMMUNICATION SCIENCES (ITS)**, in Boulder, CO, is NTIA's chief engineering and research arm. ITS is a centralized Federal laboratory that addresses a great diversity of technical issues associated with telecommunications. ITS addresses both spectrum related and wireline issues associated with telecommunications.

NTIA's **OFFICE OF POLICY ANALYSIS AND DEVELOPMENT (OPAD)** is responsible for NTIA's domestic communications policy development. Specifically, OPAD develops and articulates policy recommendations on the introduction of competition into, and deregulation of, U.S. telecommunications and information services (including traditional telephony and common carrier services), wireless communications (including cellular radio, paging and personal communications services and non-licensed voice and data devices), and mass media (including radio and television broadcasting and cable television). OPAD analyzes policy issues relating not only to what we call here the telecommunication conduits but also the content traveling through those conduits.

OPAD examines specific issues relating to: Universal service and open access; Privacy; Content regulation and the First Amendment; Electronic commerce; and other issues relating to the National Information Infrastructure (NII) initiative.

As part of its duties, OPAD prepares wide-ranging studies of the U.S. telecommunications industry and the public policies that underlie the Federal Government's role in them. OPAD prepares, with the assistance of NTIA's Office of the Chief Counsel, documents that NTIA offers to the "FCC" advocating Executive branch positions on telecommunications policy issues. These are usually formal written comments or letters from NTIA's Administrator in response to Notices of Proposed Rule Making and Notices of Inquiry issued by the FCC on particular regulatory matters.

OPAD also administers NTIA's Minority Telecommunications Development Program (MTDP), which was created to develop programs and policies that promote the growth and development of minority ownership in the telecommunications industry. MTDP's ComTrain program provides training in broadcast management for minority owners of full-service commercial radio and television stations who have been in business fewer than 3 years.

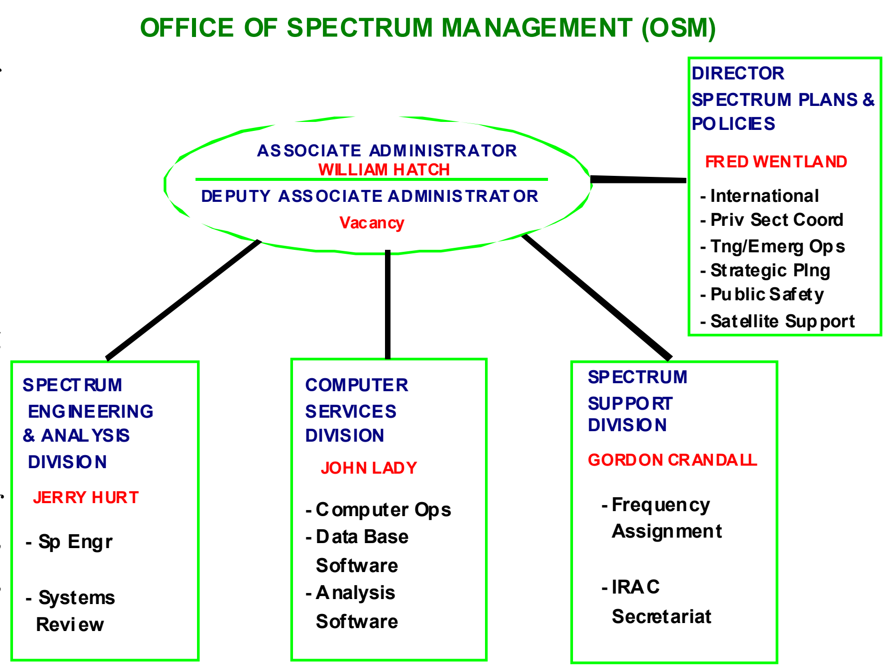
NTIA AND SPECTRUM MANAGEMENT

NTIA's *Manual of Regulations and Procedures for Federal Radio Frequency Management,* U.S. Department of Commerce, National Telecommunications and Information Administration, Washington, D.C. 20230, contains extensive information on the mission and structure of NTIA's spectrum management program. In addition, it contains the rules and procedures used by NTIA in its management of the spectrum. It is available from the U.S. Government Printing Office.

NTIA's authority in spectrum management policy is extensive. The National Telecommunications and Information Administration Organization Act clearly provides that NTIA shall assign frequencies and approve the spectrum needs of new systems for use by the Federal government. Federal users must obtain frequency assignments before they can operate transmitters.

OFFICE OF SPECTRUM MANAGEMENT

Pursuant to the delegations from the President and the Secretary of Commerce, the Administrator of NTIA is the ultimate authority in all spectrum management decisions for the Federal Government, except frequency assignment decisions, which can be appealed to the Director of the Office of Management and Budget. The Administrator, in turn, has delegated most spectrum management decisions to the Associate Administrator for NTIA's Office of Spectrum Management. OSM carries out its responsibilities for managing the Federal Government's use of the radio frequency spectrum using the organizational structure shown. OSM's divisions and offices are responsible for various parts of the spectrum management task.



The **OFFICE OF SPECTRUM PLANS AND POLICIES (SP&P)** is responsible for developing spectrum management policies. SP&P prepares, updates and publishes the ***Long Range Plan for the Management and Use of the Radio Spectrum*** and ***War Emergency Readiness Plan for the Use of the Radio Spectrum***.

These plans lay the ground work for use of the spectrum in the future and during wars and domestic emergencies. SP&P is also the principal party responsible for providing technical guidance and support, participating in and implementing the results of International Telecommunication Union radio conferences and technical meetings.

The **OFFICE OF COMMUNICATIONS AND INFORMATION INFRASTRUCTURE ASSURANCE PROGRAM (CIIAP)** carries out the lead responsibilities assigned to the Department by the President under E.O. 13010 and designated to NTIA by the Secretary of Commerce to address the Nation's needs for protection of its critical communications and information (I&C) infrastructures. The Assistant Secretary of Commerce for Communications and Information and Administrator of NTIA is the Government Sector Liaison Official under Presidential Decision Directive 63 for the I&C sector. The program will coordinate the efforts of the private and public sectors since the critical I&C infrastructure is owned and operated by the private sector.

The **SPECTRUM ENGINEERING AND ANALYSIS DIVISION (SEAD)** provides the technical and analytical support for spectrum policy development. It prepares a number of highly technical reports each year. The reports evaluate the effect of existing and planned systems and policies on the radio spectrum. SEAD evaluates proposed Federal radiocommunication systems for compliance with regulations and standards and for compatibility with other present and planned systems, and provides technical and analyses support to the IRAC.

The **COMPUTER SERVICES DIVISION (CSD)** provides the computer hardware and software necessary for modern spectrum management.

The **SPECTRUM SUPPORT DIVISION (SSD)** provides administrative and executive secretariat support to the Interdepartment Radio Advisory Committee (IRAC). It is responsible for processing frequency authorization requests from Federal Government agencies with the assistance of the IRAC's Frequency Assignment Subcommittee (FAS) and recommending approval to the OSM Deputy Associate Administrator. SSD also coordinates non-government frequency requests (through the FCC's FAS representative), and coordinates Federal Government frequency assignment matters with the Canadian and Mexican governments.

INTERDEPARTMENT RADIO ADVISORY COMMITTEE

NTIA draws upon the advice of the Interdepartment Radio Advisory Committee to perform its spectrum management functions. The current member agencies of the IRAC are the 20 most active

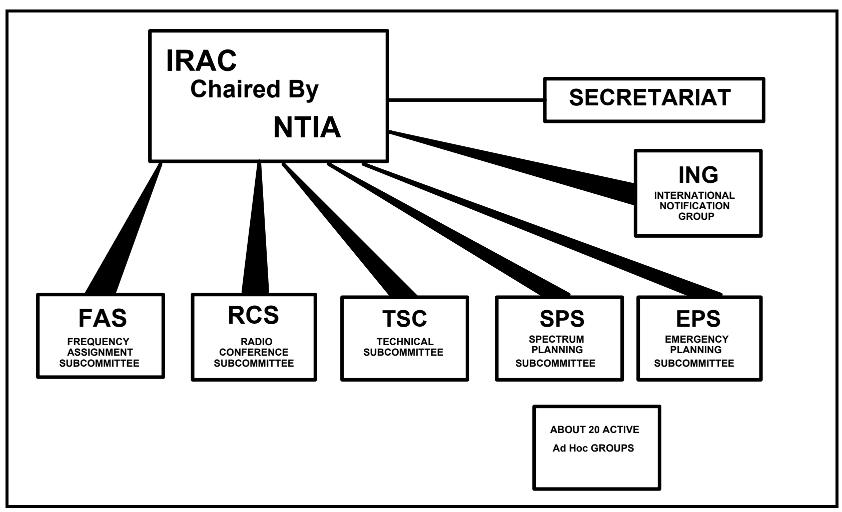
Federal users of the spectrum and a liaison representative from the FCC. The IRAC reports to the OSM Deputy Associate Administrator, who serves as its chair. The IRAC consists of a main committee, five subcommittees, a group for notifying frequencies to the ITU, and over 20 *ad hoc* working groups that consider various aspects of spectrum management policy as shown in the organization chart on the next page. NTIA provides to the IRAC Executive Secretariat support, technical advice, and usually the chairs of the IRAC's subcommittees.

> Section 103 of the NTIA Organization Act enables the Secretary of Commerce to establish interagency advisory committees, such as the IRAC as follows:
>
> > The authority to establish, as permitted by law, such interagency committees and working groups composed of representatives of interested agencies, and consulting with such departments and agencies as may be necessary for the most effective performance of assigned functions.
>
> Section 103 also assigned to the Assistant Secretary heading the NTIA that function.

Its By-Laws indicate that the primary function of the IRAC is to:

> . . . assist the Assistant Secretary [of Commerce, through the Deputy Associate Administrator of OSM] in assigning frequencies to U.S. Government radio stations and in developing and executing policies, programs, procedures and technical criteria pertaining to the allocation, management, and use of the spectrum.

In addition, the IRAC forum provides a mechanism for coordinating Federal use of the spectrum and resolving interference conflicts among the Federal agencies.



Representatives on the IRAC propose new frequency assignments, describe required new radiocommunication systems, and raise spectrum management issues of interest to their agencies. The IRAC considers each request and provides a recommendation to the NTIA, via the OSM Deputy Associate Administrator (also the IRAC Chair); NTIA may accept, reject, or modify the recommendation. Members can appeal findings of any subcommittee to the main committee or to NTIA at any time.

The IRAC's permanent substructure, shown in the box above, includes the Frequency Assignment, the Spectrum Planning, the Technical, the Emergency Planning, and the Radio Conference Subcommittees and the International Notification Group.

The **Frequency Assignment Subcommittee (FAS)** assists the NTIA in assigning radio frequencies by providing review of, coordination on, and recommendations for approval of applications for use of frequencies, and by developing and recommending procedures for processing these applications.

The **Spectrum Planning Subcommittee (SPS)** develops both recommendations to NTIA, on behalf of the IRAC, regarding agency requests for spectrum support for new systems and plans for use of the spectrum.

The **Technical Subcommittee (TSC)** assists NTIA in developing policies, programs, procedures, and technical criteria regarding the allocation, management and use of the spectrum.

The **Radio Conference Subcommittee (RCS)** assists the NTIA in preparing for International Telecommunication Union (ITU) conferences including the development of recommended U.S. proposals and positions.

The **Emergency Planning Subcommittee (EPS)** formulates, guides, and reviews national security/emergency preparedness (NS/EP) planning for Federal spectrum-dependent systems. The EPS maintains the NTIA Emergency Readiness Plan for Use of the Radio Spectrum (ERP) to reflect current plans and procedures; reviews the war emergency functions supported by spectrum-dependent systems along with their proposed, associated spectrum-use priorities; and, ensures emergency spectrum management planning and practice are in accordance with current NS/EP telecommunications policy.

The **International Notification Group (ING)** prepares responses to the ITU concerning questionnaires and other correspondence related to the notification of United States frequency assignments.

The membership on these subcommittees, groups, and the *ad hoc* committees includes representatives of agencies affected by the work of the committees.

SPECTRUM PLANNING AND POLICY ADVISORY COMMITTEE

The Frequency Management Advisory Council (FMAC or Council) provided advice to NTIA on spectrum management matters from its inception in 1965 to 1991. FMAC was composed of "15 non-Federal members . . . appointed by the Secretary of Commerce to insure a balanced representation in such functional areas as manufacturing, analysis and planning, operations, research, academia, and international negotiations (***NTIA Manual***, Part 1.5.3)." FMAC was subject to the provisions of the Federal Advisory Committee Act, 5 U.S.C. App. 2 §9 (Supp. 1990). The chair of the FMAC was the Associate Administrator of OSM. While FMAC meetings were open to the public, the FMAC was not designed to provide day-to-day public input to NTIA. It was not tasked to obtain or present the views of the public on spectrum management issues. The FMAC therefore reflected principally the views and considerable expertise of its members.

Our recent *Spectrum Management Policy* study concluded that a private-sector/Government-agency planning group consisting of experts from both the private sector and from the Government agencies should be established to provide input from both sectors for spectrum planning. This advisory committee could address both specific, immediate problems and long-term issues to assist NTIA and the FCC in developing unified spectrum management plans and policies. Therefore, in 1991 NTIA expanded the FMAC to include several government sector representatives and to expand its role to include a strategic planning function. In order to reflect this changed mission, in 1993 we changed the name to the **Spectrum Planning and Policy Advisory Committee (SPAC).**

FURTHER INFORMATION

General questions concerning spectrum management practices and procedures at NTIA should be addressed to:

Norbert Schroeder
Program Manager
U.S. Department of Commerce
Room 4099, Herbert C. Hoover Building
1401 Pennsylvania Avenue, NW
Washington, DC 20230.

Telephone (202) 482-6207.
Facsimile (202) 501-6198.

Additional information concerning spectrum management can also be obtained from the following at the *U.S. Department of Commerce, Room 4099, Herbert C. Hoover Building, 1401 Pennsylvania Avenue, NW, Washington, D.C. 20230.*

William Hatch, (202) 482-1850
Associate Administrator, Office of Spectrum Management

Fredrick Wentland, (202) 482-1850
Director of Spectrum Plans and Policies, Office of Spectrum Management

General questions about NTIA policy concerning telecommunications and information should be addressed to:

John F. Sopko, (202) 482-1840
Acting Assistant Secretary for Communications and Information

Sarah Maloney, (202) 482-1835
Chief Policy Coordination Division & Chief Information Officer

APPENDIX

USE OF THE SPECTRUM BY FEDERAL AGENCIES

DEPARTMENT OF DEFENSE

GENERAL — USE OF THE RADIO FREQUENCY SPECTRUM BY THE MILITARY SERVICES

The paramount requirement of military communications-electronics (C-E) is to provide telecommunications, navigation, and special purpose electronic systems that are responsive to the requirements of the National Command Authorities, the Joint Chiefs of Staff, the Commanders of Unified or Specified commands, the Services, and defense agencies in the accomplishment of designated missions and functions in peacetime, contingency situations, and at all levels of conflict, including general nuclear warfare. The DOD develops and produced Military C-E systems to perform functions that: accommodate crisis management, support nuclear strategy, and meet other wartime requirements. These systems are designed to facilitate a rapid transition from peace to war and to satisfy peacetime needs. The nature of the systems and the functions to be performed, make military tactical and strategic operations highly dependent on the usable radio frequency spectrum.

The above factors demand that sound engineering and administrative practices be applied by the military services toward ensuring efficiency in the management and use of the radio frequency spectrum to support operations. Under normal peacetime conditions, military service needs are satisfied while minimizing the impact on other users through efficiently exercised management. Service needs are met so that the primary uses of the spectrum are in conformity with the National and International Radio Regulations. Other needs are met on a noninterference basis. The management of the frequency resources required to support a balanced and operationally effective training/contingency program for the military force structure requires a constant effort to refine and improve management functioning. It is only through diligent and progressive management and continued technological advancement that the radio frequency spectrum requirements, incident to national readiness and security, can be met adequately.

A short description of each of the military services' dependence on radio frequencies is presented below.

DEFENSE INFORMATION SYSTEMS AGENCY (DISA)

DISA engineers, manages and operationally directs the Defense Communications System (DCS) which provides the long-haul worldwide communications for DOD. The DCS includes wire and fiber optic land cables, submarine cables, extensive worldwide networks of troposcatter, microwave, and high frequency radio systems, and the satellites and earth terminals of the Defense Satellite Communications System (DSCS). The Military Departments provide the individual components of the DCS, and are responsible for the operation and maintenance of the facilities. The frequency spectrum of concern to DISA ranges from the lower portion of the high-frequency band up through the EHF radio frequencies, and into laser frequencies used in the fiber optic cables.

DEPARTMENT OF THE ARMY (DA)

The Office of the Director of Information Systems for Command, Control, Communications, and Computers is responsible for all electronic communication, computer and information management activities for the Army. The Army Spectrum Manager, who reports directly to the Director of Information Systems for Command, Control, Communications, and Computers, is responsible for ensuring unity of effort in frequency support and radio regulatory matters, and for providing policy guidance on any interdepartmental or host nation issues. He and his staff address objectives, policy, radio regulatory positions and resource management within the Army, including training of frequency personnel, and interfaces spectrum matters with other DOD and Federal agencies and with the FCC.

Additionally, organizations under the direction of the Army Spectrum Manager make frequency assignments for use by the Army within the Continental United States (CONUS). The Communications Electronics Service Office (CESO) provides national and international level support to Army spectrum management activities including coordination of spectrum use with other government agencies, participation in national and international spectrum management forums, certification of spectrum dependent equipment, and management of host nation agreements to support use of spectrum dependent equipment. The Army Frequency Management Office (AFMO) CONUS and the Area Frequency Coordinators at White Sands Missile Range and the Electronic Proving Grounds provide the vital link between national spectrum management and Army operations. These organizations directly respond to frequency action requests from operational tactical units, administrative support units, research and development organization and other Army efforts.

Due to the high mobility of Army operations, the dispersal of Army units, and the wide range of Army spectrum dependent systems, Army frequency use requires extraordinary planning. Army frequency management techniques and procedures will continue to change to support Army acquisition of modern real time frequency agile systems and those requiring high data rates and related increases in bandwidth. This dynamic environment presents a unique challenge to Army frequency management offices and to those organizations with which the Army shares the radio frequency spectrum.

The trend in Army spectrum-dependent systems is toward embedded automation and signal processing techniques to improve information exchange. Emphasis in new design is to operate in a radio interfering environment, and to provide maximum tuning ranges for assignment flexibility in different ITU Regions and to solve local spectrum congestion problems. Experimental work continues at EHF in both equipment design and radio propagation sciences. Data transfer requirements placed upon tactical radio relay systems have increasingly driven bandwidth, interoperability and flexibility in supporting computer techniques, such as time division multiplexing and packet switching.

Training at individual and unit levels has increased radio spectrum requirements for communications, weapon systems and countermeasure tactical systems. The Fort Irwin, California, and Fort Polk, Louisiana, National Training Centers are instrumented for unit testing. The Army rotates its forces through the Centers as part of the annual testing and evaluation of training. The Army is reviewing its frequency management process to achieve the highest use and training capability while limiting potential interference.

Army aviation operates in the National Airspace with air navigation and tactical radar systems, VHF and UHF equipment for aviation communications and tactical equipment for communications with Army tactical forces. In addition to its airborne activities, the Army provides personnel and operations for four air traffic control areas. The Corps of Engineers (Civil Works) maintains 41,000 kilometers of navigable waterways, locks, and local traffic controls. In this role, nationally established maritime radio facilities and procedures are used. In addition, the Corps of Engineers operates a fleet to support its missions, which operate on Army channels.

The Corps of Engineers also operates radio sensing and remote controls for 66,000 dams with most of them producing electric power. This requires approximately 1600 kilometers of microwave radio relay systems. The Corps of Engineers generates one-third of all Army frequency assignment actions in the conterminous United States.

DEPARTMENT OF THE NAVY (NAVY)

The Department of the Navy includes the Executive Office of the Secretary of the Navy, the Office of the Chief of Naval Operations, the Headquarters U.S. Marine Corps, and other commands and activities in Washington, D.C. The Navy also includes reserve components, all shore and field activities under the control of the Secretary of the Navy, and, in time of war or when the President so directs, the U.S. Coast Guard. Navy and Marine Corps forces are organized equipped, trained, and prepared to maintain a constant state of readiness for immediate and sustained offensive and defensive operations on and under the seas, on land, and in the air.

Since the end of the Cold War, the Navy has been redefining missions and concepts-of-operations, in recognition of the new military challenges presented by the post-Cold War world. The overarching document, "*Forward ... From the Sea,*" offers a new vision based on revised strategy and military operational needs for regional conflicts in the world's littoral zones and on new technological capabilities for current and future use. The future warfighting environment will involve cooperative, long-range engagements and require a highly responsive command, control, communications, computers, intelligence, surveillance and reconnaissance (C4ISR) decision cycle. This projected future environment has moved information and the requirement for information superiority to the forefront in all thinking about the conduct of naval warfare. Warfighters now require information superiority – the capability to collect, process and disseminate information, while denying an adversary's ability to do the same. The requirement for information superiority was a key element in the development of the naval vision for C4ISR, known as Copernicus. Copernicus is the initiative to gain information superiority and make C4ISR systems responsive to the warfighter; to field these systems quickly; to capitalize on advances in technology; and to shape doctrine to reflect these changes. Embodied in the Copernicus initiative is the naval concept of Network Centric Warfare (NCW) which is the vision for complete integration of C4ISR systems.

Vice Admiral A. Cebrowski, OPNAV N6, Director for Space, Information Warfare, Command and Control defined NCW as:

> *Warfare which derives its power from the robust networking of a well informed but geographically dispersed force. The enabling elements are a highly webbed information service, access to all appropriate information sources, weapons reach with precision and speed of response, value-added command and control processes – to include high speed automated assignment of resources to need – and integrated sensors hosted on the information network and closely coupled in time to the shooters and C2 process. Network centric warfare is applicable to all levels of warfare and contributes to the coalescence of strategy, operations, and tactics. It is transparent to mission, force size and composition, and geography.*

The Navy's overarching program for achieving the command and control elements of NCW is Information Technology for the 21st Century (IT21). As first steps toward implementing IT21 requirements and meeting NCW, the Navy has begun fielding several C4I programs. While several programs are under development, the following represent the thrust of IT21: The Global Command and Control System – Maritime (GCCS-M) program provides for the common operational picture and collaborative planning in the near term, Link 16 provides part of the Coherent Tactical Picture, and the Cooperative Engagement Capability (CEC) for air and missile defense. CEC manifests the potential to increase combat effectiveness by linking geographically dispersed sensors, of differing capabilities, with all potential firing platforms.

Operational Maneuver From the Sea (OMFTS) is the Marine Corps' capstone operational concept "for maritime power projection." Two fundamental changes in the operational environment hastened OMFTS: (1) The prominence of the threat characterized by the phrase "chaos in the littorals" and, (2) Enhanced tactical capabilities based on technical advances in information management, battlefield mobility and lethality of conventional weapons. The concept presents a vision of what "operational maneuver from the sea" is and what capabilities naval forces of the future should possess. OMFTS requires vastly greater C4ISR capabilities than those of today, since the distance from which movement ashore will begin is much greater than current operations and there will be no intermediate pause on the way to the objective.

Operation of communication-electronic equipment, systems and subsystems is a necessity to support, coordinate, and control Marine Air/Ground Task Forces and other independently operating Fleet Marine Force units. The equipments and systems that require frequency spectrum are tactical radios, sensors, battlefield surveillance radars, air defense radars, tactical data link terminals and satellite communications links. To meet its mission response requirements, the U.S. Marine Corps conducts amphibious training exercises routinely around the world, often with allied forces.

To achieve the coordination necessary to conduct joint operations, our forces require the capability to 'train as you fight' within the littoral waters of United States. The RF spectrum is the only medium that can support the Navy and Marine Corps increased mobile communications requirements associated with NCW and OMFTS. Assured access to the electromagnetic spectrum is essential for the Department of the Navy strategic and tactical systems to fulfill their communications, intelligence, surveillance, reconnaissance, and weapon guidance missions both in times of peace and during conflict.

The operating forces of the Navy and Marine Corps are primary means of force projection and peacekeeping in furtherance of National policy. The Navy can conduct operations unilaterally, jointly with forces of other U.S. Military services, and with allied forces in combined operations. Such operations bring a heavy concentration of sophisticated electronics systems into a constrained area and place heavy demands on the electromagnetic spectrum to accommodate the necessary C4ISR flow without mutual electromagnetic interference. The sophisticated defensive and offensive detection, location, and weapon systems necessary to accomplish the mission also place heavy demands on management and use of the electromagnetic spectrum.

Naval Electromagnetic Spectrum Center (NAVEMSCEN)

NAVEMSCEN manages the Department of the Navy's (DON) use of the radio frequency electromagnetic spectrum needed for the control and exploitation of sea, air and space. NAVEMSCEN is the Navy's primary responsible organization for carrying out Chief of Naval Operations (CNO) electromagnetic spectrum management policy and procedures. The NAVEMSCEN provides direct support to operational radio frequency spectrum users by obtaining and documenting all frequency assignments used to support Navy and Marine Corps operations worldwide. They also register Navy and Marine Corps HF and satellite frequency assignments with the International Frequency Registration Board of the International Telecommunications Union. NAVEMSCEN's primary responsibilities are:

- Support the business processes necessary to obtain spectrum access for military dependent systems

- Represent its Service C4I Chief (CNO N6) on spectrum management issues
- Coordinate spectrum management issues within joint, DOD, national, and international forums
- Partner with the acquisition and operational communities of the DON actively to assist them in identifying and following the spectrum management processes.

Major Systems Commands (SYSCOMS)

Naval Sea Systems Command (NAVSEASYSCOM) The NAVSEASYSCOM is the Navy Department's central activity for designing, engineering, integrating, building and procuring U.S. Naval ships and shipboard weapons and combat systems. NAVSEASYSCOM's responsibilities also include the maintenance, repair, modernization and conversion of in-service ships and their weapons and combat systems. Additionally, it provides technical, industrial and logistics support for naval ships, and ensures the proper design and development of the total ship, including contractor-furnished shipboard systems. Other important NAVSEASYSCOM functions include introduction of ships to the Fleet; the Navy's salvage and diving operation; explosive ordnance safety and disposal; coordination of naval ship conversion and repair for both the Department of Defense and the Military Sealift Command; and support of ship construction for the Maritime Administration. NAVSEASYSCOM manages 135 Acquisition programs, which are assigned to the Command's 7 affiliated Program Executive Officers (PEOs) and various Headquarters elements. Organizationally, as of June 1, 1998, the Command had 38 subordinate shore activities and more than 150 detachments and on-site offices. These organizations are located all over the United States and a small number are overseas.

Naval Air Systems Command (NAVAIRSYSCOM) The NAVAIRSYSCOM Team (TEAM) comprises:

- NAVAIRSYSCOM
- Naval Inventory Control Point (NAVICP)
- Program Executive Office, Air Anti-Submarine Warfare, Assault, and Special Mission Programs PEO(A)
- Program Executive Office, Cruise Missiles Project and Unmanned Aerial Vehicle Joint Project PEO(CU)
- Program Executive Office, Tactical Aircraft Programs PEO(T) and
- Program Executive Office, Joint Strike Fighter PEO(JSF)

Working with industry, the TEAM delivers high quality, affordable products and support to the operating forces. Products and services delivered include aircraft, avionics, air-launched weapons, electronic warfare systems, cruise missiles, unmanned aerial vehicles, launch and arresting gear, training equipment and facilities, and all other equipment related to Navy and Marine Corps air power. Total life cycle support of all naval aviation weapons systems include: research, design, development, and engineering; acquisition; test and evaluation; training facilities and equipment; repair and modification; and in-service engineering and logistics support. Ultimately, NAVAIRSYSCOM's goal parallels that of their customers – to reconstitute the Fleet's assets with new and modernized weapons systems, technically and functionally able to respond to the demands of the 21st century.

Space and Naval Warfare Systems Command (SPAWARSYSCOM) – SPAWARSYSCOM is responsible for directing the development, acquisition, and life cycle management of C4ISR systems for the United States Navy, and select Marine Corps and joint service programs. Most of the frequencies within the Department of Navy are generated by C4ISR systems under SPAWAR cognizance. The mission of SPAWAR is to provide Naval commanders a decisive warfare advantage through the development, acquisition, and life cycle management of effective and responsive:

- Battle management systems
- Undersea, terrestrial, and space sensors
- Information transfer systems
- Information management systems, and
- Systems for selective denial of these capabilities to opposing forces.

To implement this mission, SPAWAR is organized into six Program Directorates (PD) with a Chief Engineers Office that supports the entire command:

- Advanced Concepts and Technology PD
- Space technology Systems PD
- Global Information and Network Systems PD
- Information Warfare Systems PD
- Communications System PD
- ISR Systems PD
- Office of Chief Engineer

In addition, three systems centers provide engineering and technical support to the program directorates:

- SPAWAR Systems Center, Charleston
- SPAWAR Systems Center, Chesapeake
- SPAWAR Systems center, San Diego

DEPARTMENT OF THE AIR FORCE (USAF)

The mission of the Air Force is to defend the United States through the control and exploitation of Air and Space. To accomplish this mission, the Air Force uses several subsidiary organizations, the first level of which includes the Major Commands (MAJCOM). The MAJCOMs are assigned specific duties and organized functionally within the conterminous United States and by geographic area overseas (to include Hawaii and Alaska). The Air Force also uses, at the same level as MAJCOMs, but separate from them and generally smaller in scope and size, Field Operating Agencies (FOAs) and Direct Reporting Units (DRUs). While MAJCOMs accomplish a broad, overall mission, FOAs and DRUs have a more specific mission. There are eight MAJCOMs, two of which are outside the continental United States. The following paragraphs discuss the ways in which the Air Force uses the radio frequency spectrum, first for the MAJCOMs, then for six FOAs: Air Force Command, Control, Communications and Computer Agency; the Air Force Frequency Management Agency; the Air Intelligence Agency; the Air National Guard; and the Air Force Reserve.

Major Commands

Air Combat Command (ACC). The ACC operates combat-coded fighters, bombers, tankers and reconnaissance aircraft, and organizes trains, equips and maintains rapid-response, combat-ready forces. ACC is the Air Force component command for the U.S. Atlantic Command (USACOM) and U.S. Strategic Command (USSTRATCOM), and provides nuclear-capable forces for the latter. ACC subordinate numbered air forces are the air component commands for U.S. Central Command (USCENTCOM) and U.S. Southern Command (USSOUTHCOM). ACC operates specific air mobility assets in support of U.S. Transportation Command. ACC also tests new combat equipment, and monitors and intercepts illegal drug traffic, and provides air defense forces for North American Aerospace Defense Command. Additionally, ACC is the lead command for the Combat Air Forces (CAF), which includes ACC, PACAF, USAFE, AFSPS, AFSOC, AETC, ANG and AFRES.

ACC is the Air Force's largest user of the spectrum. It employs the entire range of electronic RF radiating equipment including special weapon systems, navigation aids, radio location devices, and command and control systems. ACC provides aircraft and Theater Air Control System (TACS) equipment to carry out close air support, air surveillance, air control, and communications connectivity within a combat zone. It also operates an extensive early warning system providing detection, identification, surveillance, and interception for national air defense. ACC is also responsible for the Air Force Search and Rescue and for unmanned aerial vehicle operations.

Data and communication systems used by ACC include; satellites, ground and airborne radar, Joint Surveillance System, Joint Tactical Information Distribution System, drone control and target scoring, tactical VHF and UHF air-to-ground and air-to-air systems, HF single side band, electronic warfare and countermeasures, enemy threat simulators, navigational aids, air traffic control, and many land mobile radio systems. ACC also operates the Airborne Battlefield Command Control Center, Airborne Warning and Control System, the Joint Surveillance Target Attack Radar System, and the National Airborne Operations Center, aircraft.

ACC's worldwide mission requires extensive and continuous use of the radio frequency spectrum. The combination of ACC's unique mission requirements and complex operational systems, places a heavy demand on the spectrum. As the force provider to the warfighters and the service proponent for fighter and bomber operations, ACC's mission of putting bombs on target could not be met without unencumbered use of the spectrum.

Air Education and Training Command (AETC). Known as the "First Command," AETC recruits, assesses, commissions, trains and educates Air Force enlisted and officer personnel. AETC provides basic military training; basic and advanced technical training; flying training; and professional military and degree-granting professional continuing education for officer, enlisted, and civilian personnel. AETC conducts joint, medical service, and readiness training and Air Force security assistance training for allied and friendly foreign nations. It uses many of the same operational radio communications equipments as the rest of the Air Force, but in a training environment. The equipment used for training includes Land Mobile Radios, radars, HF, VHF and UHF radios, and satellite communications. AETC also uses Land Mobile Radios in direct operational support of their training exercises for point-to-point communications and data links.

Air Force Materiel Command (AFMC). Through integrated management of research, development, test, acquisition, and support, AFMC advances and uses technology to acquire and sustain superior systems in partnership with its customers. AFMC performs continuous product and process improvement throughout the life cycle. As an integrated part of the Air Force warfighting team, AFMC contributes to affordable combat superiority, readiness and sustainability.

AFMC actively develops and acquires the most advanced systems for Air Force use, and its use of the radio frequency spectrum is as wide as that of the entire Air Force. Approximately one-fifth of the radio frequency assignments for Air Force operations are to satisfy AFMC requirements. Recognition of the radio frequency spectrum as a finite and vital resource requiring prudent use and management is intrinsic to the AFMC mission. The enhancement of national defense would be diminished if new USAF equipment were not compatible with intended environments or were in frequency bands either overcrowded or allocated for different radio services. Research, development, test, and support activities conducted at AFMC laboratories, product centers, air logistics centers, base operating sites, test ranges, and those at the facilities of contractors, rely heavily on the radio frequency spectrum.

Air Force Space Command (AFSPC). The AFSPC operates space and ballistic missile systems, including ballistic missile warning, space control, space lift, and satellite operations. AFSPC supports terrestrial forces and civil and commercial space activities. AFSPC supplies: Air Force Satellite Control Network, Ballistic Missile Warning System, Cobra Dane radar, Defense Meteorological Satellite Program, Defense Satellite Communications System, other military satellite communications systems such as MILSTAR, Defense Support program satellites, the Fleet Satellite Communications System, the Global Positioning System (GPS), Ground-based Electro-Optical Deep Space Surveillance System, NATO III communications satellites, Passive Space Surveillance System, Pave Paws radars, and Perimeter Attack Characterization System.

AFSPC, which is responsible for all Air Force and many, DOD, U.S., and NATO satellite systems, needs access to the radio frequency spectrum. Each satellite needs telemetry, command, and control and many are used specifically for radio frequency communications. Since most satellite receivers are extremely sensitive, they must be protected from spurious emissions from other transmitters. The warfighter needs satellite communications during the entire conflict. Moreover, the DOD and our allies need the radio frequency spectrum for the safety and well-being of the warfighters in a hostile, foreign land.

Air Force Special Operations Command (AFSOC). The AFSOC is, the Air Force component of U.S. Special Operations Command. AFSOC deploys specialized air power, delivering special operations combat power anywhere, anytime. AFSOC provides unconventional warfare, direct action, special reconnaissance, counter terrorism, and foreign internal defense support to the unified commands. AFSOC also provides humanitarian assistance and personnel recovery and conducts psychological and counter narcotics' operations. To complete its various missions worldwide, AFSOC must have extremely versatile radiocommunication equipment to be compatible with that used by the forces with which it must cooperate. This includes other DOD departments and foreign allies. AFSOC also needs communication and other radio frequency equipment that are interception- and jam-resistant.

Air Mobility Command (AMC). The AMC provides rapid, global airlift and aerial refueling for U.S. armed forces. AMC is the USAF component of U.S. Transportation Command, and supports wartime tasking by providing forces to theater commands. AMC also provides operational support aircraft, aeromedical evacuation missions, and visual documentation support.

There are three categories of AMC spectrum usage: fixed, tactical, and contingency or deployable. The fixed category consists of high Frequency Automated Link Establishment for the AMC Command and Control (C2), and HF training networks. Combat Control Teams use the VHF band for tactical and joint operations for communications at drop zones landing zones and training by the Air Mobility Warfare Center. AMC uses the VHF-AM frequency band for Air Traffic Control operations. AMC also uses the VHF band for air-to-ground, ground-to-air, and land-mobile communications for contingency and deployable operations in support of tanker Airlift Control Elements. Several globally assigned frequencies in the UHF band support the Tanker Airlift Control Center air-to-air refueling program. Additionally AMC uses this band to support daily flight and command post operations. The

Air Mobility Operations Groups use UHF satellite communications extensively for fixed and contingency operations. AMC uses operating frequencies in the UHF band for land mobile operations at AMC bases, and for communications during deployments.

Pacific Air Forces (PACAF). The PACAF plans, conducts and coordinates offensive and defensive air operations in the Pacific and Asian theaters, including Hawaii and Alaska. PACAF organizes, trains, equips and maintains resources to conduct air operations. It operates in a multinational environment where it can interact with many different types of equipment and radio frequency standards. The equipment in its aircraft in Alaska and Hawaii must interact with the equipment used in the rest of the Pacific and in Asia, for the safety of the people in those aircraft and on the ground at the air strips where these aircraft might go.

United States Air Forces in Europe (USAFE). The USAFE trains and equips units pledged to the North Atlantic Treaty Organization (NATO). USAFE plans, conducts, controls, coordinates and supports air and space operations in Europe. It supports U.S. and NATO strategies in the European/Mediterranean area and is responsible for supporting U.S. military plans and operations in parts of Europe, the Mediterranean, the Middle East, and Africa as a component of U.S. European Command. Since USAFE also has to interact with many different countries, its equipment must be compatible with many different types of equipment and radio frequency standards, including the United States'.

Field Operating Agencies

Air Force Communications Agency (AFCA). The AFCA ensures command, control, communications and computer (C4) systems across the Air Force are integrated and interoperable. They develop and validate C4 architectures, technical standards, requirements, policies, procedures and technical solutions.

The AFCA does not itself have a large need for the radio frequency spectrum. Nevertheless, it helps to insure the Air Force's equipment uses the spectrum efficiently and productively and that the equipment is interoperable with the other equipment used in the Air Force and the Department of Defense. The AFCA ensures that all Air Force C4 acquisitions are compatible and interoperable with other existing or proposed C4 systems. They extensively test new civil technologies acquired for Air Force use to insure compatibility.

Air Force Frequency Management Agency (AFFMA). The AFFMA serves as the Air Force executive agent for implementing Air Force use of the radio frequency (RF) spectrum. It provides the Air Force with global electromagnetic spectrum access anytime anywhere. AFFMA develops and implements Air Force RF spectrum management guidelines and instructions to support the Air Force mission. The AFFMA is directly responsible to the Commander, Air Force Communications and Information Center (AFCIC) for all Air Force RF spectrum management matters.

The AFFMA provides support to operational RF spectrum users by obtaining and documenting frequency assignments used to support Air Force operations worldwide. They register Air Force HF and satellite frequency assignments with the Radiocommunications Bureau of the International Telecommunications Union. They represent, advocate, and defend Air Force interests in spectrum management matters on various DOD, national, and international committees, groups, and organizations to include the Technical Subcommittee, Frequency Assignment Subcommittee, and the Spectrum Planning Subcommittee of the IRAC as well as being the Air Force executive agent for the Air Force Electromagnetic Environmental Effects (E3) program. They also coordinate assignment actions with unified commands for operations outside the U.S. and its Possessions. The AFFMA does not itself use the radio frequency spectrum.

Air Intelligence Agency (AIA). The AIA provides direct intelligence security, electronic combat, foreign technology and treaty monitoring support to national leaders and field air component commanders. The AIA provides combat commanders' data that enables them to decide when to exploit, jam, deceive, or destroy hostile military communications. The AIA delivers human intelligence and scientific and technical intelligence. It provides measurement and signature intelligence data collection, analysis and exploitation support, and nuclear intelligence production support. In the age of information warfare, the AIA is extremely important since it not only helps gather information from possible and real enemies, but also keeps them from doing the same to the U.S. and its allies.

To be successful AIA must have real-time data gathering from its units around the globe, and real-time data distribution to commanders in the field. To do this AIA needs a large amount of radio frequency spectrum, as there is no other way to ensure global connectivity in a variable, unstable environment, such as an armed conflict or war. The AIA uses satellite communications for real-time global connectivity with all of its locations. Because of the sensitivity and essentiality of its communications, it is critical that no one intercepts or corrupt these communications. The AIA uses UHF air-to-ground communications with its airborne units, and has a worldwide UHF satellite intelligence network for data gathering and distribution. The AIA also uses UHF satellite communications for verification of conformance with the Nuclear Proliferation and Consolidated Test Band Treaties.

Air National Guard (ANG) The mission of the ANG is to enforce federal authority, suppress insurrection and defend the nation when mobilized by the President, Congress, or both. The ANG is commanded by the governors of the 50 States, Puerto Rico, Guam, the Virgin Islands and the commanding general of the District of Columbia. An adjutant general represents each governor in the state or territory chain of command.

The ANG has operational components of ACC, AETC, AFSOC, AMC and PACAF, and therefore has a need to have component equipment from all of these NWCOMS. The ANG might also use equipment used by these MAJCOMs, so its radio frequency spectrum use is very wide. The ANG also operates during a time of national emergency or natural disaster, and during war or armed conflict, so they have a continuous need for the radio frequency spectrum.

NATIONAL TEST RANGES

The national test ranges test missiles and other major weapons systems that are critical to the Nation's defense. All of the U.S. military services, Army, Air Force, Navy, and Marine Corps, conduct test programs for major weapons systems, and use of the radio frequency spectrum is critical to the operation of these test programs. The demand for radio frequency spectrum duringland, sea and air force weapons systems testing and training, in particular during joint exercises, is greater today than ever before.

At the lower end of the spectrum, Ground-to-Air, air-to-air, and Ground-to-Ground VHF/UHF for aircraft communications and Land Mobile Radio systems are continually used to provide positive control of test range operations. Flight termination frequencies provide for safety concerns. Data links cover a wide range of operations including fixed microwave links, weapon and missile data links, telemetry for real-time data and video, and instrumentation control links starting and controlling tracking cameras, and various other event critical activities. Testing sophisticated vehicles (aircraft, land vehicles, sea craft, rockets and missiles) require enormous amounts of performance data. Further uses of data links include remotely controlled explosive ordinance disposal systems, control of sub-scale and full-scale drone aircraft and other Unmanned Aerial Vehicles, and command control and command destruct links.

Radar systems are vital for many aspects of testing. Uses include missile and aircraft tracking radars with associated transponders, air traffic control radars, weapon scoring systems, weather radars for monitoring weather conditions that might affect a test mission, and missile guidance radars. Aircraft and missile testing require extensive communications-linked tracking and data collection sites over large areas.

Finally, the development and testing of Electronic Countermeasures (ECM), Electronic Counter-Countermeasures (ECCM), or Electronic Attack (EA) systems are major activities at many national test/training ranges. Many ranges are used for routine ECM/ECCM/EA training of combat aircrews. ECM/ECCM/EA systems are used to jam, confuse or otherwise render potential enemy radio frequency weapons systems (such as, radar guided missiles, surveillance radars, and jammers) ineffective. ECM testing against simulated threat system radars is critical to development and testing of our advanced technology weapon systems electromagnetic countermeasures to find their capabilities, vulnerabilities, and weaknesses.

RESERVE COMPONENTS

In addition to the regular Armed Forces, there are reserve units of the Army, Navy, Air Force, and Marine Corps, including the Army National Guard, Air National Guard and the Coast Guard in the United States. The mission of the reserve is to provide trained units and qualified personnel to augment the active duty forces and to provide a combat ready team during time of war, national emergency or when required to maintain national security. Reserve units perform peacetime missions that are compatible with training and mobilization readiness requirements. The reserve routinely conducts exercises with extensive use of communications-electronic equipments and relies heavily on all parts of the radio frequency spectrum for its communications, command, and control capabilities. Since the reserve units must be combat ready anytime, they must train with the same equipment as active-duty personnel, and they have the same radio frequency spectrum requirements as their active duty counterparts throughout U.S. forces worldwide.

CONCLUSION

The Military Departments, both on unilateral and Joint bases, are critically dependent upon the usable radio frequency spectrum in the fulfillment of requirements incident to the defense and security of the Nation. In making use of this resource, the military is acutely aware of the need for diligent care in the management of this spectrum. Many measures toward improvement are underway and the military establishment will continue to devote maximum effort to this endeavor. The Military Services carry the frequency engineering and management function out at a level thoroughly familiar with and immediately responsive to the requirements of the operating forces. This function is an integral part accomplished close to major policy making levels (intra service, joint, and DOD) to ease referral of issues needing high level attention. Furthermore, the needs of the military departments are unlike the needs of the civil agencies and commercial corporations: the military departments need global interoperability and immediate response to any crisis without limiting our warfighting capabilities for the safety and security of the American people and our allies.

U.S. GOVERNMENT CIVIL AGENCIES

INTRODUCTION

The use of radio by the government Civil Agencies supports many missions distributed among several departments and agencies. One primary use is for mobile radio communications between mobile and portable stations and between mobile and fixed land stations. These radios generally are used in support of law enforcement, transportation, resource protection, and coordination of activities over wide areas. The Federal agencies together have about $4.5 billion invested in these types of radios and have obtained 60,000 authorizations to operate such systems, not including those used to navigate aircraft and ships. The use of these types of mobile radio is essential to the timely completion of critical missions in each agency, which often involves safety of life and property issues. A brief description of selected agency missions and uses of the spectrum follows.

DEPARTMENT OF AGRICULTURE

The Department of Agriculture's use of radio is primarily dedicated to the protection and management of National Forests, National Grasslands, and Wilderness Areas, which comprise approximately 192 million acres. The 60,000 radios of the U.S. Forest Service are used in programs supporting wild firefighting, by law enforcement, timber production, emergency disaster control (earth-quakes, volcanic eruptions, hurricanes, etc.), operation of recreation sites, control of watersheds and water supply areas, wildlife and grassland conservation, and forest research. Some 6,500 additional pieces of electronic equipment are devoted to the support of other agricultural, hydrologic, and research activities. Increasing communications needs in the Natural Resources Conservation Service, Animal and Plant Health Inspection Service, and other Agriculture department agencies have resulted in a rapid increase in numbers of radios. As an example, the Natural Resources Conservation Service's Meteor Burst Hydrologic system in the West consists of more than 500 stations.

DEPARTMENT OF COMMERCE

In the Department of Commerce, the largest user of the radio spectrum is the *National Oceanic and Atmospheric Administration (NOAA),* which manages, conserves and monitors marine resources and predicts atmospheric and marine conditions for the protection of life and property. The *National Weather Service (NWS),* with personnel at 121 Weather Forecast Offices throughout the United States, observes and reports the weather, issuing forecasts and warning of weather and flood conditions affecting national safety, welfare and economy. Its seven National Centers for Environmental Prediction are key centers in long range and regional forecasting for the World Meteorological Organization of the United Nations. Its Tropical Prediction Center also tracks hurricanes and forecasts their movement and intensity to provide early warnings to populated areas in the storm path.

NWS operates about 120 weather radars, 102 weather balloon stations, 503 NOAA Weather Radio Stations, and, with state and local governments, 3437 hydrological data collection and warning stations. It also operates many other radio stations serving the GOES (platform station) program, the hydrologic telemetry program, the fire-weather program, the hurricane backup communications program, the weather reconnaissance aircraft program, and other miscellaneous radio requirements.

The *National Environmental Satellite, Data, and Information Service (NESDIS),* operates remote sensing satellites that make day and night observations of weather (clouds, temperature, and winds), ocean state (sea surface temperature), geological and agricultural features over the entire Earth. Satellite transmitters transmit these data and other environmental data to ground stations using radio frequencies. The data are gathered at the ground and re-transmitted via commercial satellites to a central processing center. The meteorological satellite system also provides for the collection and radio relay of data from fixed and mobile environmental observing platforms (ships, aircraft, ocean buoys, and remote surface sites).

The NOAA Data Buoy Center develops and operates environmental data buoys for weather monitoring, prediction, and various other scientific programs. Data is sent from the buoys and platforms via UHF signals through the GOES and NOAA satellites to land via downlinks near 1700 MHz. More than 10,000 data collection platforms currently use the data collection radio relay service of the meteorological satellites. These observation platforms are operated by NOAA, other government agencies, and private industry to obtain data on stream flow and water quality, snow depth, and rainfall in remote mountain areas, oceanic measurements from buoys and remote islands, and wind and temperature information from commercial aircraft.

The polar orbiting weather satellites of the NOAA include Search And Rescue Satellite (SARSAT) System packages that detect distress signals sent by radio to the satellite and provide a location within 2-5 km. Three ground stations in the United States, one in Canada, one in France, and three in Russia receive the transmitted data from the SARSAT. In addition, NESDIS operates the National Geophysical Data Center collecting data from 33 worldwide ionospheric sounders (LF through HF frequency bands.)

The *National Marine Fisheries Service (NMFS),* conducts exploratory fishing and fish and marine mammal population research programs using HF and VHF radio equipment to provide tracking and migration information and communications between major fishery centers and research ships of the NOAA Corps Fleet. NMFS also enforces Federal fish and wildlife conservation laws relating to the living marine resources within the U.S. 320-kilometer jurisdictional fishery conservation zone. VHF radio communication is an essential factor during these operations.

The *National Ocean Service (NOS)* radiocommunication facilities are used to support some 23 ships and 18 mobile field parties engaged in oceanographic, marine and geodetic surveys, and NMFS activities. The NOS conducts these programs, activities, and related radiocommunications to measure the Earth's surface, its coastlines and its undersea structure and to provide information on the marine environment and its resources for use by scientists and the public. NOS also publishes many nautical charts for use by mariners for improved safety of life at sea. Communications are principally for safety, control of navigation, operations, medical emergencies, and administrative messages between ships conducting joint operations and between ships and shore stations using NOS, NMFS, Navy and U.S. Coast Guard commercial communication circuits. The Charting and Geodetic Services, an office of NOS, also use radio frequencies in the visible and infrared spectrums for very precise distance measurements. The VHF frequency band is used for voice communications between field parties. Including the Office of Oceanography and Marine Assessment uses radiocommunications to coordinate cleanup teams and track movement of contamination when responding to oil and hazardous chemical spills.

The *National Institute of Standards and Technology (NIST),* through its Boulder, CO facilities, is responsible for primary time and frequency standards, and dissemination of these data through radio stations WWV and WWVB in Colorado and WWVH in Hawaii to more than one hundred thousand listeners throughout the world. NIST also disseminates data through dial-up telephone service (2 million users per year) and GOES and GPS satellites. High precision time signals are sent and received from domestic communication satellites at 14 and 12 GHz. NBS also conducts extensive experimentation using the radio spectrum in such areas as testing instruments for earthquake calibration measurements. Specific areas of radio usage include communication, data telemetry, and satellite transfer of information.

THE DEPARTMENT OF ENERGY (DOE)

Mission

Public Law 95-91 of 1977 established the DOE by consolidating energy functions within the Federal Government. Its mission is to provide information and the scientific and educational foundation for the technology, policy, and institutional leadership necessary to achieve efficiency in energy use, diversity in energy sources, a more productive and competitive economy, improved environmental quality, and a secure national defense. In support of this mission, DOE has identified five business lines that most effectively use and integrate its unique scientific and technological assets, engineering expertise, and facilities for the benefit of the Nation. These five business lines are economic productivity, energy resources, science and technology, national security, and environmental quality.

An Overview of Current Spectrum Use

Although each of DOE's five business lines uses spectrum resources, the energy resources and national security business lines use the most. Land mobile systems primarily support the other business lines — economic productivity, science and technology, and environmental quality. They deploy both conventional and trunked land mobile systems. The spectrum use for each DOE business line is discussed in the following paragraphs.

National Security

This business line supports and maintains a safe, secure, reliable, and smaller nuclear weapons stockpile, without nuclear testing; safely dismantles and disposes of excess weapons; and provides the technical leadership for national and global non-proliferation to reduce the continuing and new nuclear dangers in the world. Initiatives include the National Ignition Facility, the Advanced Strategic Computing Program, the Non-proliferation and Verification Research and Development Programs, and the Los Alamos Neutron Science Center. DOE places primary importance on safely dismantling nuclear warheads, ensuring the safety of operations, protecting the environment, managing our nuclear weapons complex, and cost-effectively consolidating our non-nuclear manufacturing activities.

Science and Technology

The objective of this business line is to use the unique resources of the Department's $30 billion laboratories and their 40,000 scientists and engineers to maintain world class leadership in basic and applied research in support of the Department's other business lines. Fundamental research maintains the Nation's world leadership in science, mathematics, and engineering. Research in energy and environmental sciences is paving the way for a more sustainable energy future. Opening our scientific and technological resources to industry will improve the Nation's productivity and economic growth.

Energy Resources

This business line develops and deploys energy efficient and renewable energy technologies; advances the efficient and environmentally responsible production, transportation, and use of conventional energy sources; promotes the development of sustainable energy technologies with high export potential; promotes an equitable system of energy supply and end use; and reduces U.S. vulnerability to energy supply disruptions. In carrying out the Energy Policy Act of 1992, DOE's programs are expected to save homeowners $17 billion and businesses $12.5 billion per year by 2005 and to create almost 310,000 jobs. Moreover, DOE's transportation technology programs are expected to reduce oil imports by 2.3 million barrels a day by 2000, creating a savings for drivers and improve the balance of trade by $47 million per year.

Power Marketing Administrations. The five Power Marketing Administrations market electricity generated primarily by 125 Federal hydropower projects throughout 33 states from Alaska to the east coast. More than 56,000 km of high voltage transmission lines carries the electrical energy to Federal, public bodies, and cooperatives. Revenues from selling electricity are used to repay annual operation and maintenance costs, repay the capital investments with interest, and assist capital repayment on irrigation features of certain projects.

The distribution of electrical energy from the generating plants to the load centers and the interconnection of bulk electrical power supply systems for reliability and adequacy have resulted in extremely complex national networks aimed at the optimum economic configuration. The systems have, as integral and critical parts, extensive administrative and operational telecommunications for voice and data transmissions to prevent brownouts and blackouts. These facilities must be of the highest reliability, economically and technically feasible, and must be instantly available for the successful operation of the Nation's electrical power systems. Some of these telecommunications facilities are shared with other Federal departments and agencies and some must interface with utilities of the private sector.

Petroleum Reserves. The Strategic Petroleum Reserve, created in 1975, gives the U.S. adequate strategic and economic protection against severe oil supply disruptions. The Strategic Petroleum Reserve program provides for the storage of 680 million barrels of crude oil in underground salt caverns at five sites in the Gulf Coast area and connected to major private sector distribution systems. A series of Executive Orders established the Naval Petroleum and Oil Shale Reserves between 1912 and 1924 to provide emergency liquid fuel supplies for national defense. Oil production at the three sites since they have been opened has been approximately 750 million barrels. Natural gas production at these sites has been about one billion thousands of cubic feet. Natural liquid gas production at these sites has been approximately two billion gallons.

Environmental Quality

This business line protects public health and the environment by understanding and reducing the environmental, safety, and health risks and threats from DOE facilities and develops the technologies and institutions required for solving domestic and global problems. The DOE is cleaning up the environmental legacy left from more than 50 years of nuclear weapon production – a period when environmental standards and laws were much less stringent than what they are today. The department is using its scientific and technical expertise to help accomplish clean up, but the challenge is enormous. Clean up involves the safe treatment, storage, and final disposal of radioactive wastes, surplus nuclear materials, and spent nuclear fuels that remain at the sites of the nation's nuclear weapons facilities and energy research and development sites. Also, DOE is working on a long-term, permanent disposal site for the growing inventory of spent nuclear fuel from commercial reactors. Internationally, the department is also working to ensure that other countries effectively clean up the environmental legacy of the cold war.

Economic Productivity

This business line promotes sustained U.S. economic growth by stimulating the creation of high-wage jobs and diversity in research and development collaborations with industry and universities. This growth further helps drive products into the domestic and international marketplace, helps industry become more competitive by cost-effectively shifting from waste management to resource efficiency and pollution prevention, and stimulates global DOE technology usage and exports. The DOE's vast technological and research resources can thus enhance industry's productivity and maximize the return on taxpayer investment in those resources by providing economic benefits to the Nation that go beyond the original mission of the laboratories.

Summary of DOE Spectrum Use

The DOE, at an investment of almost $1 billion, has about 9,600 frequency authorizations supporting mission, programmatic, and operational requirements. These systems include high frequency, land mobile, aeronautical and maritime mobile, microwave, satellites, radar, navigation, telemetry, and surveillance systems. In addition, DOE uses more than 1,000 power line carrier systems to manage and control the distribution of electrical energy.

The DOE's current radio systems operate at specific frequencies between 200 kHz and 35 GHz. About 60% of the Department's spectrum resources are used for land mobile systems followed by 25% for microwave systems and 10% for high frequency systems for emergency purposes. The remaining 5% is for radar, telemetry, and satellite services. DOE's power line carrier systems operate at selected frequencies between 8 kHz and 496 kHz.

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA was established in the executive branch as an independent agency in 1979 to provide a single point of accountability for all Federal emergency preparedness, mitigation and response activities. FEMA develops, coordinates, and executes plans and programs providing for continuity and effective operation of the Federal Government during national emergencies; provides facilities and resources for management and coordination of emergency information; and provides centralized coordination and control and day-to-day management of the National Emergency Management System (NEMS). NEMS consists of the total telecommunications and data processing resources necessary for FEMA to accomplish its assigned peacetime and wartime functional responsibilities and meet all established operational requirements under the Integrated Emergency Management System (IEMS) umbrella. Current capabilities of NEMS include the National Warning System, the FEMA National Teletype System, the FEMA National Voice System, the FEMA National Radio System, and the capability to activate the Emergency Broadcast System at the direction of the President.

GENERAL SERVICES ADMINISTRATION (GSA)

The GSA has the responsibility to protect Federal property under its charge and control and to ensure a safe, secure environment for conducting Government activities. Protection includes: 21,000 space assignments, housing 887,000 Federal employees in 6,800 government-owned and leased buildings. The primary use of GSA's radio systems are for law enforcement and buildings management operation. The radio frequency system includes portables and mobiles, base-stations, paging, intrusion detection, access control and closed circuit television. The total GSA investment in radio frequency equipment is more than $40 million.

DEPARTMENT OF HEALTH AND HUMAN SERVICES (DHHS)

The principal user of radio spectrum in DHHS is the Public Health Service (PHS). The Indian Health Service (IHS), a PHS operating agency, is responsible for about 80 percent of the approximately 1450 frequency assignments used by DHHS. The IHS supports the delivery of health care to Native Americans by using radio to communicate with emergency medical vehicles, remote health stations and mobile health units. Radio is also used extensively for paging systems to communicate with key medical personnel. In Alaska, the IHS uses both HF radio and common carrier satellite communications to provide "Doctor Call" assistance to village health aides at isolated locations. IHS radio base stations at

50 hospitals also communicate with 60 tribal government ambulance services for dispatch and control to respond to serious medical emergencies at remote Indian locations. Radio frequencies are used in remote areas in support of fresh water systems. The IHS participates in state emergency radio networks to coordinate the rendition or delivery of medical care using medical radio communication frequencies.

The Center for Devices and Radiological Health, Food and Drug Administration (FDA) and the Lister Hill National Center for Biomedical Communications, National Institutes of Health (NIH) use frequencies for experimental purposes. The NIH also uses radio frequencies to support their campus operation with paging, maintenance, administration, law enforcement, fire and public safety. The PHS also uses radio frequencies for biomedical telemetry to conduct medical research and for monitoring the treatment of patients. Radio frequencies are used by the Office of the Secretary and DHHS operation divisions for communications to control various security and administrative operations.

The DHHS Office of Emergency Preparedness uses radio frequencies to support their Disaster Medical Assistance Teams deployed in times of natural and man-made disasters. Teams have served in areas hit by hurricanes, earthquakes, and bombs and even for Operation Desert Storm. Radio communication is critical for the deployment, operation and logistical support of these teams.

DEPARTMENT OF THE INTERIOR

The Department of Interior is the custodian of 750 million acres of land and is charged with the conservation and development of the Nation’s natural resources. It has a variety of radio operations throughout the spectrum distributed among nine operating bureaus with diverse missions serving the public and protecting the country’s natural resources. The major activities using radio are for point-to-point fixed base station and mobile radios. These are used by the Bureau of Land Management, which manages one-fifth of the Nation’s gross area — some 341 million acres, for land management and protection and development of natural resources; the National Park Service, which manages some 335 parks and monuments totaling about 80 million acres, being host to more than 350 million visitors annually; the Bureau of Indian Affairs, responsible for the welfare of some 500,000 Indians and Alaskan natives on 50 million acres; the U.S. Fish and Wildlife Service, which manages more than 400 National Wildlife Refuge areas, covering 90 million acres; the Geological Survey for earthquake studies, geologic and topographic mapping operations, and for the collection of hydrologic data by both terrestrial and satellite radio communication facilities; and the monitoring of offshore oil fields by the Minerals Management Service. In all these areas of activity the primary use of radio is for the management, production and development of the Nation’s natural resources, forest and range fire suppression and protection of property and public safety.

The management, control and distribution of water by the Bureau of Reclamation is a major factor in the growth and economy of the West. Telemetry, land mobile and point-to-point radios are essential to the operation of the Bureaus 320 water storage dams and reservoirs, 344 diversion dams, 82,000 km of carriage and distribution channels and canals, and 145 very large pumping stations. These provide irrigation for more than 12 million acres of agricultural land, providing 30 million acre feet of water for the use and consumption of more than 20 million people and water for the operation of 51 hydroelectric generating plants.

DEPARTMENT OF JUSTICE

The Department of Justice plays a key role in protection against criminals and subversion, in control of the country's borders, in ensuring healthy competition of business in our free enterprise system, in safeguarding the consumer, and in enforcing drug, immigration and naturalization laws. The Department also plays a significant role in protecting citizens through its efforts for effective law enforcement, crime prevention, crime detection, and the prosecution and rehabilitation of offenders.

Organized units of the Department of Justice that use or coordinate the use of the radio frequency spectrum are:

The *Federal Bureau of Investigation (FBI)* investigates all violations of Federal laws except those assigned to another Federal agency. The FBI has jurisdiction over some 185 investigative matters including espionage, sabotage and other subversive activities; kidnaping, extortion; bank robbery; and, the assault or killing of the President or other Federal Officers. The FBI uses the majority of the frequency assignments listed for the Department of Justice.

The *Immigration and Naturalization Service (INS)* administers the immigration and naturalization laws relating to the admission, exclusion, deportation, and naturalization of aliens. Through many enforcement activities, such as the Border Patrol, the INS protects the security of the United States' boundaries and the welfare of those legally residing in the United States.

The *Drug Enforcement Administration (DEA)* controls narcotic and dangerous drug abuse through enforcement and demand reduction programs. The primary responsibility of DEA is to enforce United States laws and statutes relating to the illegal trafficking of narcotic drugs, marijuana, depressants, stimulants, and the hallucinogenic drugs. DEA conducts domestic and international investigations of major drug traffickers concentrating efforts toward the immobilization of clandestine manufacturers, international traffickers, and the origins of diversions from legitimate channels. In addition, DEA works cooperatively with other Federal, State and local agencies and independently to begin national drug abuse demand reduction programs.

The *Federal Bureau of Prisons (BOP)* supervises the operation of Federal correctional institutions and community treatment facilities; the commitment and management of Federal inmates; and the confinement and support of Federal prisoners. Correctional institutions have self contained, dedicated communications and electronics systems to provide necessary safety and security measures.

The *United States Marshals Service (USMS)* provides personal security of Federal witnesses and their families, courtroom security, protection of Federal property, and special assignments at the direction of the Attorney General. The USMS maintains the custody of Federal prisoners from time of their arrest to their commitment or release and transports Federal prisoners pursuant to lawful writs and direction from the BOP. The USMS maintains custody and control of evidence, as well as money and property, seized pursuant to Federal statutes.

The Department of Justice uses radio systems to serve the national security; to safeguard life and property; and to support crime prevention and law enforcement. The radio systems used to carry out these responsibilities consist primarily of land mobile radio facilities. Tactical communications among investigative, protective and enforcement personnel in the field and liaison communications with cooperating law enforcement organizations are essential operational tools. Mission success and safety of life and property are frequently dependent upon the availability of radio communications systems.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION (NASA)

NASA conducts research and development in space science, astronautics and aeronautics. With the first International Space Station elements now on orbit and an aggressive manifest of missions planned through ISS completion, NASA is forging ahead toward new horizons and the challenges that await the Nation. NASA is responsible for near and deep space exploration — using both piloted and unpiloted spaceflight. Also, NASA has an ongoing terrestrial and space applications program. The Earth Observing System (EOS) missions provide new and expanded insight into the planet Earth and its environment. All of NASA's R&D and application programs are dependent on access to the radio spectrum resource.

The total NASA investment in low Earth orbit and deep space tracking facilities and other support functions – using various radio telecommunications devices and systems – is well over $2.5 billion.

From an operational point of view, NASA is currently providing launch and tracking support for approximately 45 spaceflight vehicles. This includes NASA, other Federal agency(ies), commercial and foreign government spacecraft or satellites. The Tracking and Data Relay Satellite System support Low Earth Orbiting satellites, providing 85%, instead of the previous 15%, visibility of all on-orbit space vehicles operating below 1200 kilometers.

NATIONAL SCIENCE FOUNDATION (NSF)

The NSF is responsible for promoting scientific knowledge, and to this end it initiates and supports fundamental and applied research in all scientific disciplines. The NSF sponsors major national and international science programs both of a special and a continuing nature throughout the Nation's academic and scientific communities, and it funds large research facilities at national centers that would be beyond the financial scope of individual institutions. Among the national centers are the National Optical Astronomy Observatories (NOAO), the National Center for Atmospheric Research (NCAR), the National Atmosphere and Ionosphere Center (NAIC) and the National Radio Astronomy Observatory (NRAO).

NOAO operates the Cerro Tololo Inter-American Observatory in Chile, the Kitt Peak National Observatory (KPNO) near Tucson, AZ, the National Solar Observatory (NSO), at Sacramento Peak, NM, and is nearing completion of the two 8-meter class, new technology GEMINI telescopes, that are located in Hawaii and in Chile. NCAR operates ground and airborne radar facilities for weather research purposes. NAIC operates the Arecibo radio telescope and planetary radar, the world's largest and most sensitive single dish transit radio telescope, as well as an ionospheric heating facility.

NRAO operates the 140-foot radio telescope at: Green Bank, WVA, the Very Large Array (VLA) near Socorro, NM and the Very Long Baseline Array (VLBA), which consists of 10 individual dishes distributed across the continental United States, Hawaii and the U.S. Virgin Islands, and used to simulate a continent-wide radio telescope in terms of angular resolution. In addition NRAO is constructing the Green Bank Telescope (GBT), which is to become operational in the year 2,000 and is going to be the largest movable antenna worldwide, and has begun development of the Millimeter Array (MMA), in collaboration with US universities and international partners. The MMA is going to be the world's most advanced millimeter-wave telescope; to be located in the High Plateau of the Andes in Chile.

The prime objective of radio spectrum management at the NSF is to ensure adequate access to the radio frequency spectrum for the scientific community's many research purposes. The spectrum plays a vital support role for experiments, with telemetry from remote sensing platforms such as balloons, meteorological sensors, ocean buoys, or transmitters attached to animals. Telecommunication links must be provided to coordinate experiments and to maintain contact with remote sites. While the magnitude of these activities is not comparable to active spectrum usage at other Federal agencies, the failure to plan adequately for allocations or obtain frequency assignments can adversely affect scientific objectives.

Furthermore, the NSF is responsible for protecting frequency bands for passive spectrum users – particularly radio astronomers; a responsibility that most other agencies do not share. Since frequency assignments generally are not made for passive use of the radio spectrum, they do not appear in statistical usage tables. However, radio astronomy is a major user of facilities and research funds by the NSF. Including the GBT and the MMA, U.S. investment in radio astronomy facilities will approach 1 billion dollars. The NSF is deeply concerned with maintaining a suitable electromagnetic environment so that radio astronomy research may continue unabated.

DEPARTMENT OF TRANSPORTATION

The Department of Transportation was established to develop national transportation programs conducive to the provision of safe, fast, efficient, and convenient transportation on land, at sea and in the air. The achievement of these objectives, particularly in the air and marine environments, is totally dependent upon the continuing availability of rapid and reliable radio communications and sufficient spectrum. Radio spectrum use by the several operating administrations of the Department serves numerous and diverse operational and technical functions. Nevertheless, these operations have a common purpose — the enhancement of the safety factor, or one or more of the other important aspects of transportation for the public.

The mission of the *Federal Aviation Administration (FAA)* is to provide the safest, most efficient, and responsive aviation system in the world for the benefit of the public. The FAA's success in the development and operation of the National Airspace System (NAS) plays a tremendous role in the Nation's Gross Domestic Product – the total economic activity generated by aviation is more than $700 billion per year and more than 8 million jobs.

To support the NAS, the FAA uses radio frequencies for communications, radionavigation, and surveillance (radar) systems. More than 50,000 radio frequencies are assigned for use at approximately 3000 air/ground communications sites, 1140 instrument landing facilities, more than 1000 omnidirectional ranges, and nearly 500 radar stations.

These facilities exist to serve the flying public and to provide for their safe and efficient transportation. This includes nearly 200,000 registered private aircraft flying more than 24 million hours per year; approximately 528 million passengers carried in air carrier and commuter aircraft; and nearly 23 million military flights to support our Nation's defense.

The FAA has an investment of approximately $10 billion of electronic equipment to support communications, navigation, and surveillance systems, operating throughout the radio spectrum. To support the explosion in air travel in the past few years, expenditures for current and new facilities and equipment in 1996 alone will total approximately $2 billion.

In addition, the FAA has annual research and development programs, funded at levels exceeding $500 million, which are pursuing improvements in communications, navigation, and surveillance systems – nearly all of which use the radio frequency spectrum. Such programs include research and development efforts in air traffic control, navigation, precision approach and landing systems, en route and airport radars, airport surface movement, aircraft separation assurance, communications navigation and satellite initiatives, weather surveillance enhancements, and many others.

U.S. Coast Guard (USCG) missions include maritime and recreational boating safety, search and rescue services, maritime law enforcement, marine environmental protection, port safety and security, aids to navigation, marine science activities, enforcement of offshore fishery laws, suppression of smuggling, and illicit drug trafficking, ice operations, both domestic and in the polar regions, maintaining a state of military readiness, and operating vessel traffic systems. The missions are carried out for the general maritime community and the use of the radio spectrum is essential in carrying out these tasks.

Radio frequencies are assigned for a variety of U.S. Coast Guard operations including: a network of about 563 ship/shore radio stations for safety and distress communications, including maritime safety broadcasts, with the general maritime community and for command and control of its own fleet of about 255 vessels and 2,100 smaller, radio-equipped rescue craft, a network of 26 aeronautical radio stations for operational control of its fleet of about 200 aircraft, a national network of differential GPS and LORAN-C radio navigation stations used by a variety of civil users. These operations are described in the World Wide Web site at <<http://www.navcen.uscg.mil>>. The total Coast Guard investment in communications-electronics installations is about $1 billion. Additionally, the investment in special equipment for use with Coast Guard operated radio navigation systems is about $0.60 billion.

Other important uses of radio by the Department of Transportation include a communication network of the St. Lawrence Seaway Development Corporation used to expedite and control the safe passage of U.S. and foreign vessels through the St. Lawrence Seaway, telemetering speed measurements, remote control and other technical operations carried out by the Federal Highway Administration concerning the development of high speed rail equipment, vehicle location techniques in programs sponsored by the Urban Mass Transportation Administration, and communications supporting the rapidly developing Intelligent Transportation System.

DEPARTMENT OF THE TREASURY

The Department of the Treasury enforces Federal laws concerning protection of the President and other designees, and those dealing with counterfeiting, fraud (including credit and debit card fraud), forgery, smuggling, moon shining, explosives and gun law violations, and tax evasion. Treasury agents and officers protect our borders from drug traffickers and smuggling and continually strive to protect our citizens and property from the threat of bombs, arson and gun violence.

The majority (approximately 60%) of the U.S. Department of Treasury's responsibilities relates to promoting prosperous and stable American and world economies and managing the government's finances. The law enforcement arm of the department protects our financial systems and our nation's leaders and seeks a safe and drug-free America. Use of wireless services and devices is critical to the department's accomplishing its core missions effectively and efficiently.

The Secretary of the Treasury, as the chief financial officer of the United States, advises the President on financial and tax policy matters. He has a staff of 1,600 in the office of the Secretary and oversees 120,000 employees in Washington, D.C., and 1,800 field offices throughout the United States and abroad. The Secretary of the Treasury accomplishes 98% of his responsibilities through Treasury's subordinate bureaus:

The *Bureau of Alcohol, Tobacco and Firearms (BATF)* is a law enforcement organization within the U.S. Department of the Treasury with responsibilities dedicated to reducing violent crimes, collecting revenue and protecting the public. The BATF enforces the Federal laws and regulations relating to alcohol, tobacco, firearms, explosives and arson.

The *Bureau of Engraving and Printing (BEP)* produces United States currency, postage stamps and other government securities that satisfy the current and future needs of the American public and the government agencies that it serves. The bureau designs, prints and furnishes a large variety of security products including Federal Reserve notes, most U.S. postage stamps, Treasury securities, identification cards, naturalization certificates, and other special security documents at its facilities in Washington, D.C. and Fort Worth, TX. The bureau also advises other Federal agencies on document security matters as well as processing claims for the redemption of mutilated currency. The BEP police are responsible for protecting and safeguarding its products from production through delivery.

The *U.S. Customs Service (USCS)* ensures that all goods and persons entering and exiting the United States do so according to United States laws and regulations. The USCS uses a variety of spectrum-dependent equipment to accomplish its missions. The USCS operates the Customs Over the Horizon Enforcement Network (COTHEN) designed to provide communications connectivity for air and land mobile users throughout the U.S. and possessions. The USCS also employs an extensive network of land mobile radio equipment to communicate among USCS personnel and between USCS personnel and other Federal, state, and local law enforcement agencies. Surveillance equipment is used to monitor/intercept conversations covertly and radar is used to track aircraft and ships trying to enter or leave the country illegally.

The *Federal Law Enforcement Training Center (FLETC)* provides quality, cost effective training for law enforcement professionals. FLETC is a partnership of Federal law enforcement organizations and faces the increasingly complex challenge of preparing Federal law enforcement officers for a demanding and hazardous environment. FLETC has been in operation for over 30 years and, currently, about 71 Federal agencies send their agents and officers to train at the main facility in Glynco, GA as well as facilities in Artesia, NM and Charleston, SC.

Federal agents and officers across the country put their safety at risk each day performing their varied missions. It is essential that the FLETC properly prepare its students with the top of the line resources to support their efforts and ensure their safety upon graduation. FLETC instructors provide training on the installation, operation, and maintenance of the wide array of devices employed by law enforcement personnel in the field. Access to the electromagnetic spectrum is fundamental to providing the training required to perform their missions once the students begin their law enforcement assignments.

The *U.S. Internal Revenue Service Criminal Investigation Division (IRS-CID)* enforces the criminal statutes concerning tax administration and related financial crimes, to encourage and achieve voluntary compliance with the Internal Revenue laws. The IRS-CID plays an active role in collecting tax on all money earned, both legal and illegal. They are responsible for the investigation and prosecution of the serious tax, currency, and money-laundering offenders. Additionally, the agents pursue the assets of those offenders for criminal and tax asset forfeiture purposes.

Congress has expanded IRS-CID's statutory authority to encompass not only criminal violations of the Internal Revenue Code but also money laundering and currency reporting violations. IRS-CID agents fill a unique niche in the law enforcement community: Financial investigators. These special agents' combination of accounting and law enforcement skills is essential to conducting investigations leading to the conviction of high profile criminals who commit increasingly sophisticated financial crimes.

The *U.S. Mint* is responsible for manufacturing and circulating, numismatic and bullion coins at the lowest possible cost and delivering those products in a timely and secure manner. The Mint expands U.S. markets through exceptional customer service, product development, and innovative marketing and sells numismatic and bullion products at a reasonable price and profit. The U.S. Mint Police are responsible for the protection of the nation's stockpiles of gold bullion and other precious assets. Mint Police use wireless services to provide security over those assets entrusted to them and the facilities in which they are developed, produced and stored.

The *U.S. Secret Service (USSS)* is charged with protecting the President, Vice President, President- and Vice President-elect, Presidential candidates, former Presidents, and their immediate families. The Secret Service also protects visiting heads of foreign states and, at the direction of the President, official representatives of the U.S. performing special missions abroad. They also are charged with protecting the White House complex, the Treasury Building and Treasury Annex, buildings, which house presidential offices, the Vice President's residence, and various foreign diplomatic missions in the Washington, D.C. metropolitan area or in other areas as designated by the President.

The Secret Service also detects and arrests persons committing offenses against the laws of the United States relating to coins, currency, stamps, Government bonds, checks, credit and debit card fraud, computer fraud, false identification crimes, and other obligations or securities of the United States. They also investigate crimes related to certain criminal violations of the Federal Deposit Insurance Act, the Federal Land Bank Act, and the Government Losses in Shipment Act.

There has been more emphasis on domestic anti- and counter-terrorism, cybercrimes and other technology threats that the Secret Service is directly involved in combating. The Secret Service was directed to design, plan and implement security for all Major Events, as defined by the National Security Council (NSC), through Presidential Decision Directive (PDD) 62. The Secret Service established the Major Event Division (MED) which can support two simultaneous Major Events. Another Presidential Directive, PDD 63, directs the Secret Service to work with other Federal agencies and the private sector through the National Infrastructure Protection Center (NIPC), to increase information sharing among organizations and to identify and put in place measures to ensure the security of the nation's critical infrastructure.

The Secret Service's mission has become more complex due to the technologically sophisticated and ever-changing world environment. Secret Service special agents, uniformed officers and technical security personnel use wireless sensors, body microphones, surveillance transceivers, detection devices, land mobile radios, and the ALERT (Advanced Law Enforcement Response Technology) mobile response vehicle program to accomplish its investigative and protective missions.

The Internal Revenue Service Reform and Restructuring Act of 1998 created the *Treasury Inspector General for Tax Administration* (TIGTA) on January 18, 1999. Congress believed there should be one independent organization solely devoted to oversight of the IRS and directed its creation through the law. The law transferred the former IRS Inspection Service to the newly formed TIGTA. TIGTA provides leadership and coordination and recommends policy for IRS activities designed to promote economy, efficiency, and effectiveness in the administration of the internal revenue laws and prevent and detect fraud and abuse in the programs and operations of the IRS and related entities. TIGTA auditors and investigators use wireless devices to assure the integrity of the nation's tax and revenue programs.

TENNESSEE VALLEY AUTHORITY

The Tennessee Valley Authority (*TVA*) is a multipurpose regional development agency. It is involved in flood control, agriculture and environmental research, forestry, recreation, and diversified industry. It is the largest electrical utility in the United States, with some 31,109 megawatts of power generating capacity in service and another 8,000 megawatts of capacity under construction to meet increasing demands. TVA's 27,200 kilometers of transmission line are used to serve 25 million people throughout the 205,000 square kilometer area. The TVA uses extensive microwave, land mobile and point-to-point radio systems to aid in carrying out its responsibilities for the management and operation of a two billion dollar per year multipurpose activity essential to the socioeconomic well being of the South.

UNITED STATES INFORMATION AGENCY (USIA)

The USIA promotes understanding abroad for the United States, its policies, its people and its culture. As the official voice of the U.S. Government, USIA plays a significant role in the achievement of long-range foreign policy objectives as it informs and explains – encouraging the maximum flow of ideas and information between the people of the United States and the people of other countries. Radio is the only means of communicating directly with peoples of other nations. USIA's global radio network, the Voice of America (VOA), consists of 107 shortwave and medium wave transmitters in the United States and ten foreign countries with a total transmitting power of over 22 million watts. A total of 960 hours of direct broadcast programming in 42 languages is transmitted overseas each week reaching an audience estimated to exceed 100 million listeners. All broadcasts originate from studios in Washington, D.C., and are transmitted simultaneously by microwave of leased satellite circuits to domestic relay stations operating a total of 75 transmitters, which receive all broadcast by leased satellite circuits or by shortwave from the relay stations. These broadcasts are then simultaneously rebroadcast on shortwave and medium wave frequencies to designated target areas. In addition to the direct broadcast, VOA operates a radio teletype network five days a week sending five regional transmissions of policy statements and interpretive material to over 100 USIA posts abroad.

U.S. POSTAL SERVICE (USPS)

The USPS's beginnings can be traced back to the birth of the nation. The Continental Congress named Benjamin Franklin the first Postmaster General in 1775. The Postal system that the Congress created was to help bind the new nation together, support the growth of commerce and ensure a free flow of ideas and information. Public Law 91-375 transformed the Post Office Department into the United States Postal Service signed by President Richard M. Nixon on August 12, 1970. The new Postal Service officially began operations on July 1, 1971. At that time the Postmaster General left the cabinet and the USPS and began to operate under a Board of Governors appointed by the President. The Board approves rates and directs the exercise of the powers of the Postal Service.

The United States Postal Service: operates 38,019 Post Offices around the country; delivers to 130 million addresses every day; handles 41% of the world's mail volume, 630 million pieces every day; has 192,904 motor vehicles; is the nation's largest civilian employer with more than 765,000 career employees; and has 2990 frequency assignments. The USPS uses radio communications for various purposes to deliver the mail to the nation. Many frequency assignments are used for mail processing, maintenance, transportation, vehicle services and law enforcement activities.

The *United States Postal Inspection Service* is the law enforcement and audit arm of the US Postal Service. Having investigated crimes involving the mails for more than 200 years, the US Postal Inspection Service is one of the oldest investigative agencies of the United States Government. Postal Inspectors have statutory authority to serve federal warrants and subpoenas, and to make arrests for postal-related offenses. Presently there are more than 2,000 Postal Inspectors stationed throughout the United States.

The US Postal Inspection Service has three basic responsibilities:

- Investigation of violations of more than 200 federal statutes relating to Postal Service crimes.
- Protection of mail, postal funds and property, and postal employees.
- Internal audit of many Postal Service financial and non-financial operations.

The US Postal Inspection Service investigates, and seeks to prevent, criminal assaults against the Postal Service or its employees and misuse of the nation's postal system. Investigative responsibilities include such offenses as: armed robberies; murder of, or assault upon, postal employees; burglaries; theft of mail; mailings of obscene matter, child pornography, bombs, and drugs; and, use of the mails to swindle the public.

Criminal investigations cover:

- Robbery – Robbery of mail, money or other property of the Postal Service from any person having custody or control thereof.
- Burglary – The forcible breaking into and entering (or attempting to do so) of any postal facility with intent to commit larceny.
- Assaults upon and murders of officers and employees of the Postal Service while in the performance of their duties or occurring because of such performance.
- Theft of mail or possession of stolen mail taken from postal custody or from authorized home and apartment mail receptacles.
- Bombs and explosives sent through the mails.
- Mail fraud – Use of the mails to obtain money or property by means of false or fraudulent pretenses, representations, or promises.
- Controlled Substances – Using the mails to distribute narcotics and other illegal controlled substances.
- Unlawful sale or possession of controlled substances by postal employees while on duty or on postal property.
- Misappropriation of postal funds by postal employees.
- Fraudulent Workers' Compensation claims filed by postal employees.
- Extortion – That portion of the extortion statute concerning a mailed threat to injure an individual's reputation or to accuse the individual of a crime.
- Obscenity – Use of the mail to distribute obscene material or unsolicited sexually-oriented advertisements.

- Prohibited matter in general – Mailing of poisons, switchblade knives, flammable materials and other hazardous material that can kill or injure an individual or injure the mail or other property.
- Counterfeiting of postmarks, postage stamps, postage meter stamps, postal cards, postal money orders and any dies, plates or engravings thereof. (Jurisdiction shared with U.S. Secret Service.)
- Revenue fraud against the Postal Service. Large postal mailers such as utility companies and retail stores whose operations generate high volumes of stamped mailing envelopes from their customers are potential targets of schemes that fraudulently reuse "washed" postage stamps. These "waste" envelopes are valuable to persons who may even claim to represent a charitable group. Instead of disposing or recycling this material, individuals remove the stamps, chemically "wash" the cancellation marks, and resell the end product at a discount.
- Theft of Postal Money Orders or the equipment used in the preparation of such orders or the fraudulent negotiation of such orders.
- Child Pornography – Use of the mails to produce or distribute.
- The United States Postal Inspection Service uses radio communications for investigative, protection, surveillance and other law enforcement activities to maintain the security of the mails and safety of personnel.

DEPARTMENT OF VETERANS AFFAIRS (VA)

President Herbert Hoover established the Veterans Administration on July 21, 1930 with the signing of Executive Order 5398. Subsequently, on March 15, 1989, President George Bush, by Executive Order, created the Department of Veterans Affairs. VA brings together, under a single agency, the responsibility for many of the veterans' programs created by Congress over the years. The VA provides health care, education, insurance, burial, and mortgage benefits to our veterans and their dependents. To coordinate the administration of services to the nation's veterans, VA uses over 3,500 radio frequency assignments for the operation of paging systems, radio dispatch facilities, emergency room and intensive care telemetry, Emergency Medical Service, law enforcement radar and radio, remote diagnosis and treatment facilities, microwave transmission systems, medical television service, transportation services, and medical facility management. VA also operates a nationwide High Frequency emergency contingency radio network to support civil operations during disasters and various Federal activities requiring coordinated medical care response.